



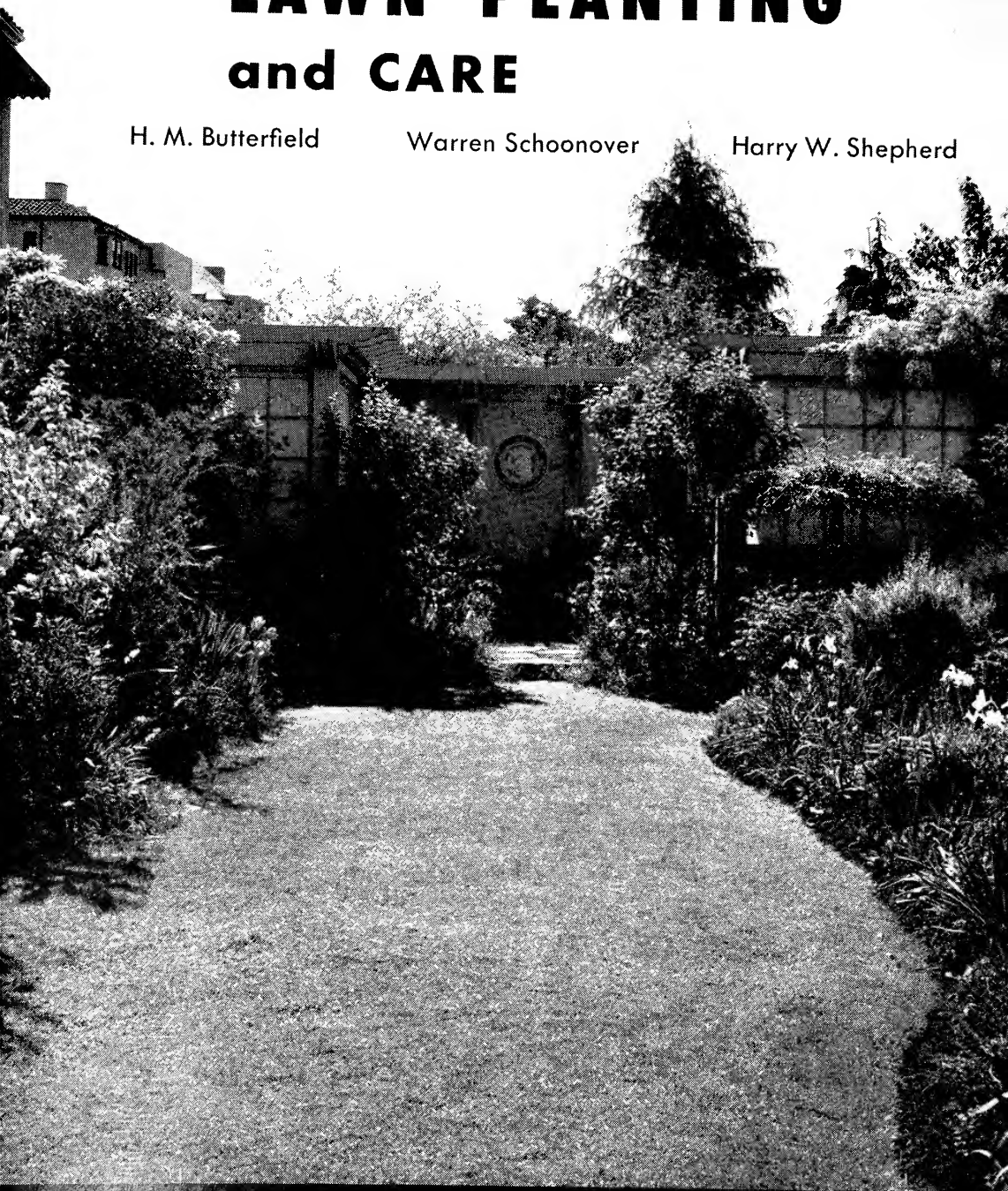
A Publication of The College of Agriculture
UNIVERSITY OF CALIFORNIA

LAWN PLANTING and CARE

H. M. Butterfield

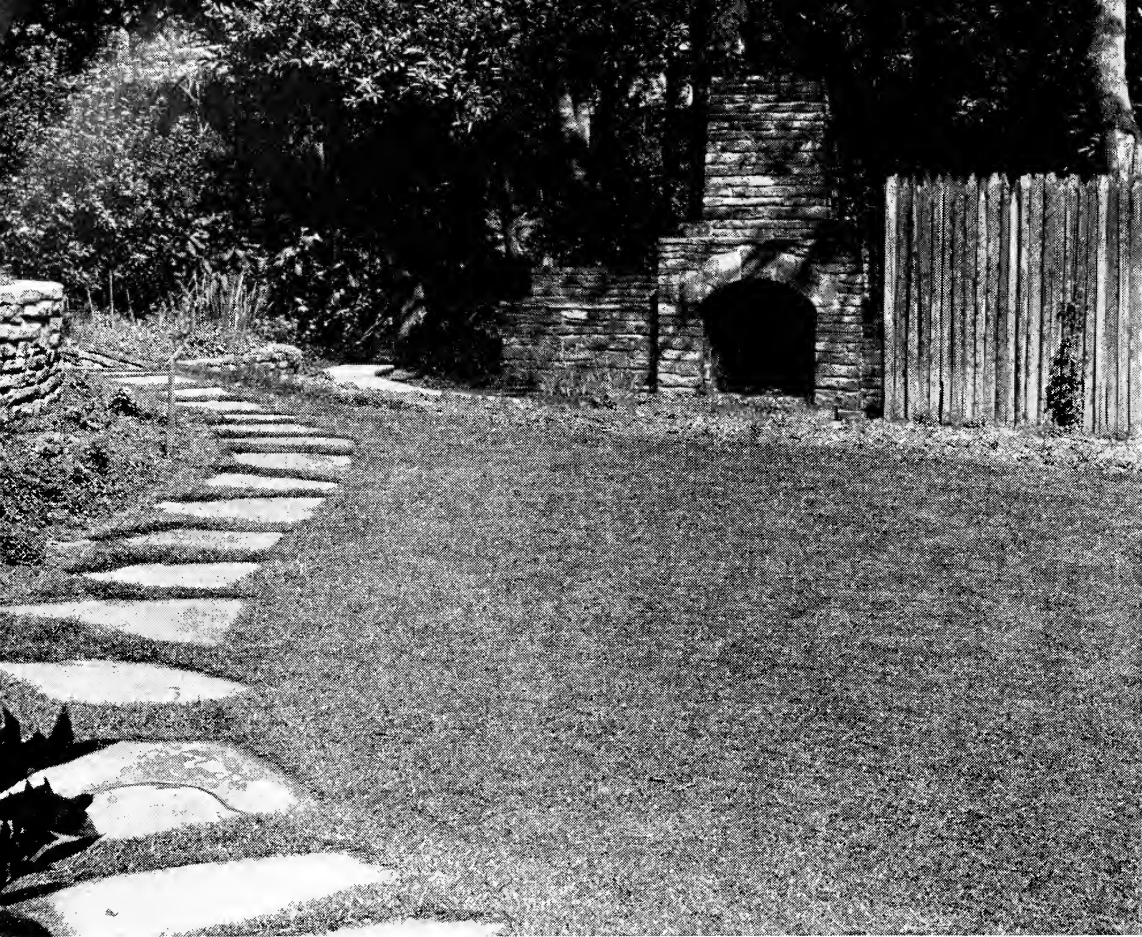
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CALIFORNIA AGRICULTURAL
EXTENSION SERVICE

CIRCULAR 181



In this garden, space is made to appear greater by the use of stepping stones
in a turf of mixed bent.

October, 1951

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A good lawn

is the result of a correctly prepared and planted seedbed. This means that a home owner needs to know what seed to choose for a particular climate and soil; how to irrigate, fertilize, and mow; and how to control lawn diseases, pests, and weeds. He also needs to know that for every 400 square feet of good lawn, at least 2½ hours of weekly care, including watering, are necessary. If business or other duties prohibit this allotment of time, it is better to landscape, at greater first cost, with brick, tile, gravel, or pavement.

A lawn may be expensive to establish if soil and climate are not favorable. If the homesite has been chosen with the requirements of plant growth in mind, however, and if the techniques of planting and care are learned, a satisfactory lawn should be easy to establish and maintain.

The essential points

of lawn planting and care under the semiarid climatic conditions of California are discussed in this circular under the following twelve headings:

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Lawn is an area of cultivated grass. Properly planted and well-kept, it has no adequate substitute. It keeps the soil from blowing and washing and, when well cared for and in good color, it is a cool, restful cover for the homesite. Even before selecting the exact location for the lawn, certain fundamental decisions must be made: the purpose of the lawn; its size; the planting of trees and the protection of existing tree roots; and the grading of the soil for contour and drainage.

Relating the Lawn to the Landscape

Gaining spaciousness. If the purpose of a lawn is an area for use as well as a setting for the house, do not plant trees or shrubbery in the center. Spaciousness is gained by grading and directing the slope, where necessary (fig. 1); by keeping the center open; and by planting large growth toward the border. There are many advantages to the open lawn, not the least of which is easier maintenance.

Placing the trees. If trees are to be grown close to the lawn, choose those that will not be damaged by lawn irrigation. Grass can be replaced, but trees are a more permanent part of the landscape.

Many California gardens are planned around aged native plants and trees, which may be injured by continuous watering of lawns during the warm months. For instance, heavy summer irrigation causes the fungus damage and sour sap so injurious to the California live oak. Heavy irrigation, especially of old lawns, where trees have grown for a long time, can also cause roots to crowd and eventually form a thick mat which prevents normal moisture penetration.

Choice of plantings and their placing are therefore very important. It is best to plant all trees, whether affected by summer irrigation or not, outside the actual lawn area. At the borders of the lawn, also, shrubs and flowers should be planted. These can be arranged in many different patterns (figures 2, 3, and 4).

Protecting established tree roots. On a homesite chosen for its growth of fine shade trees, build the house away from the trees so that grading, usually essential to construction, will not destroy

surface roots. No grading should be done within 50 to 100 feet of a tree. Paving is especially injurious to the California live oak and to aged trees, both evergreen and deciduous. The health of the roots depends on their securing the nourishment essential to normal growth.

Substituting a ground cover in shade. If dense shade is planned, it is best to plant a shade-tolerant ground cover and not insist on producing lawn grass. A good lawn is difficult to maintain even under trees giving only light shade, such as California pepper, eucalyptus, American elm, and black walnut.

Grading the soil. Grading to change land contour is expensive and often impractical, but it is sometimes necessary. All changes in slope must be gradual, not greater than 1 foot in 10 feet. This degree of slope will permit easy mowing and uniform irrigating. To maintain good turf on slopes which are more than 10 per cent is expensive. Steeper slopes require special irrigation methods which, if they include frequent irrigation, may cause excessive runoff. The gradual and easy slope is both restful to see and practical to maintain (fig. 5).

Many times the level lawn is the most practical and useful, although a gentle slope can be satisfactory. A lawn area should be full and slightly convex; otherwise it may appear hollow. To most people a slightly mounded area is more pleasing than a hollow. Slight crowning of a small lawn results in a pleasing ground line; and of a large level area, also in better drainage. Where slopes are too steep for lawn, construct terraces with retaining walls (fig. 6).

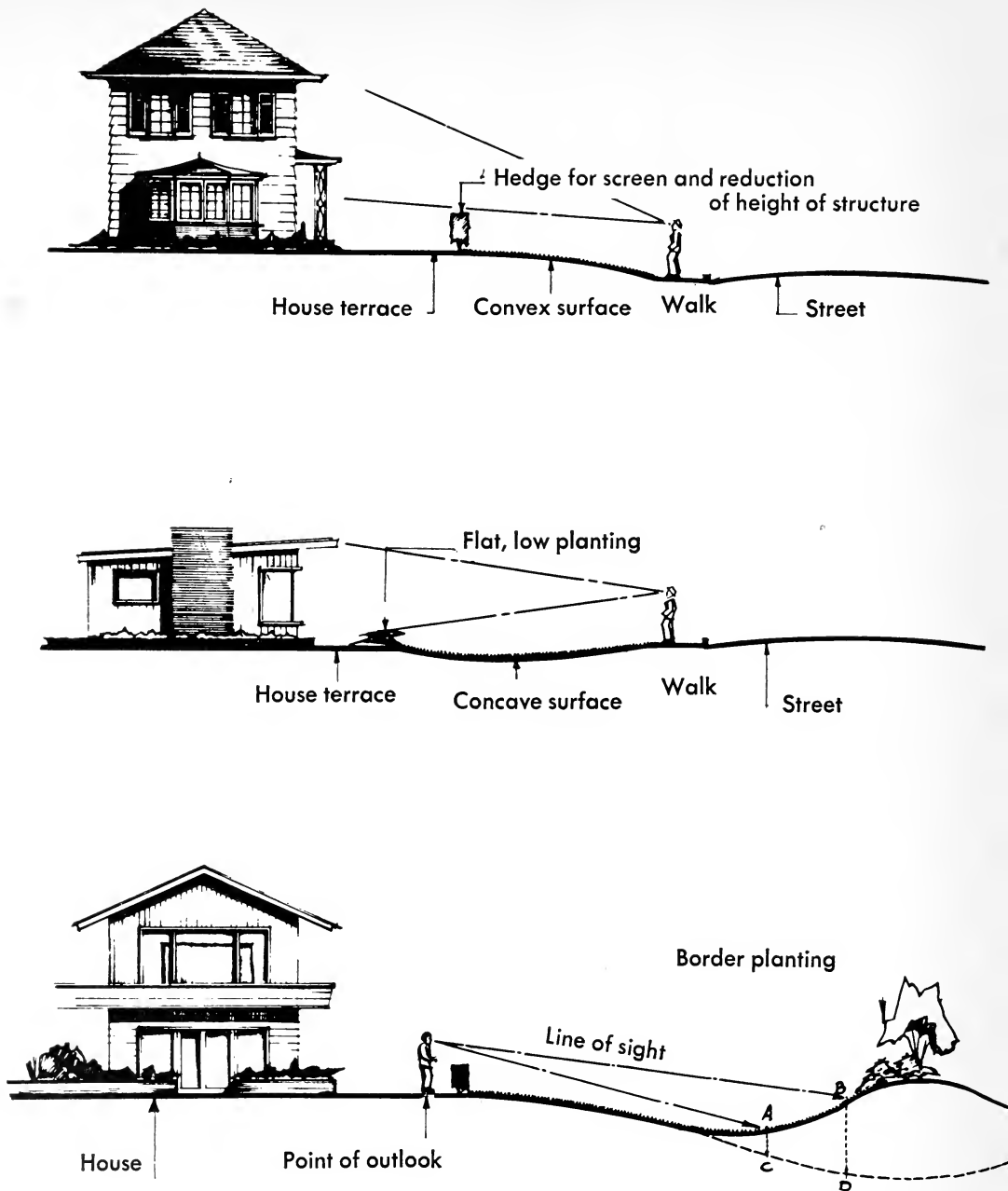
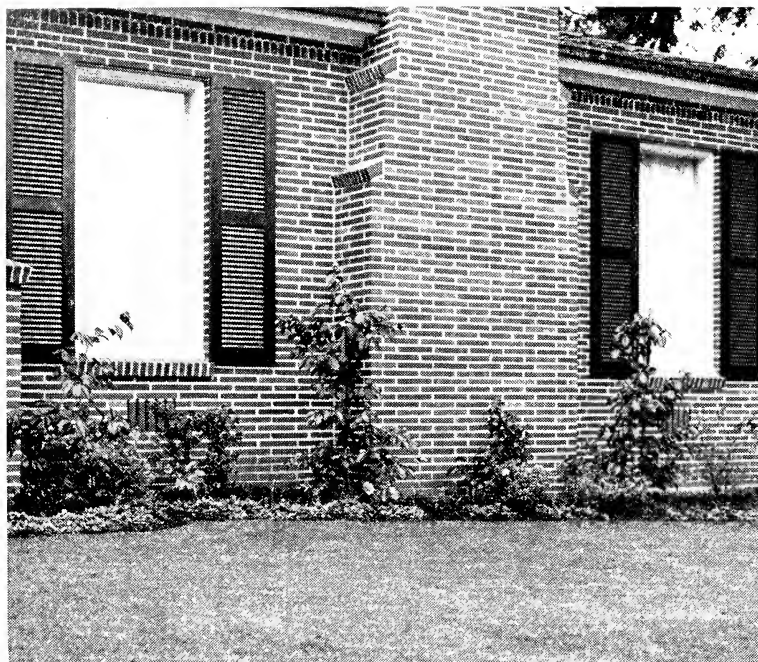
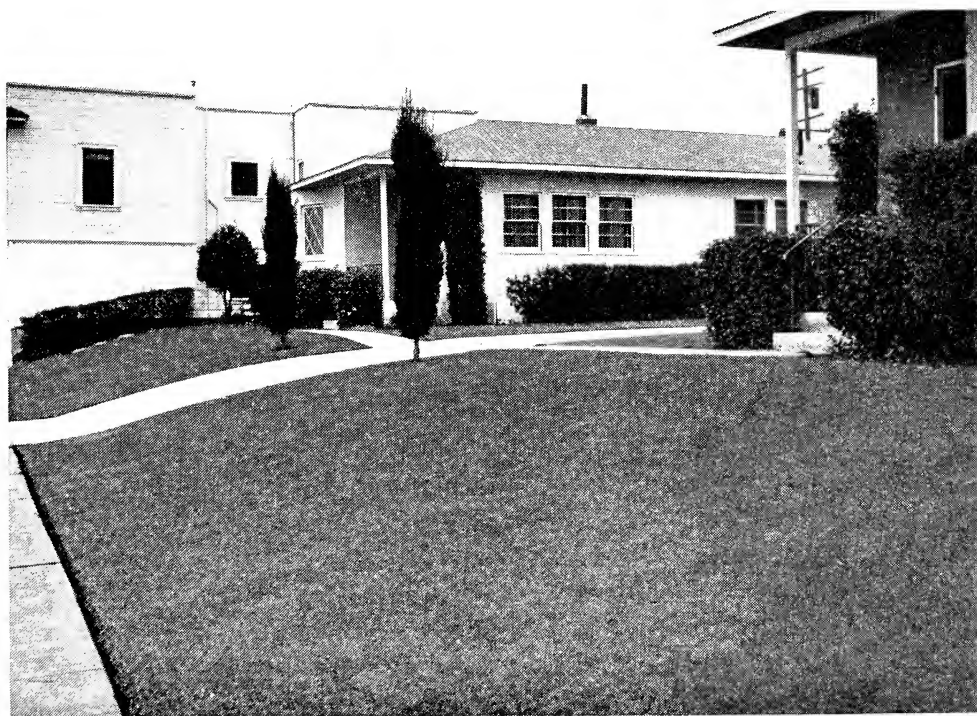


Fig. 1. Height of structure, appearance from street, and outlook should regulate nearby planting. Top: hedge between lawn and house acts as screen and reduces apparent height of structure. Middle: flat, low planting in front of a low structure. Lower: method of shaping surface to create spaciousness; also planting to define boundary and reduce apparent height of structure. All illustrations show concave and convex surfaces. (Drawings by Jack Laflin, Lecturer in Landscape Architecture.)



Left to right. Fig. 2. A simple strip of lawn in front of a border can produce a pleasing landscape. Fig. 3. At this steep hillside home, tamarix juniper, standard trimmed trees, low, dwarf box, a

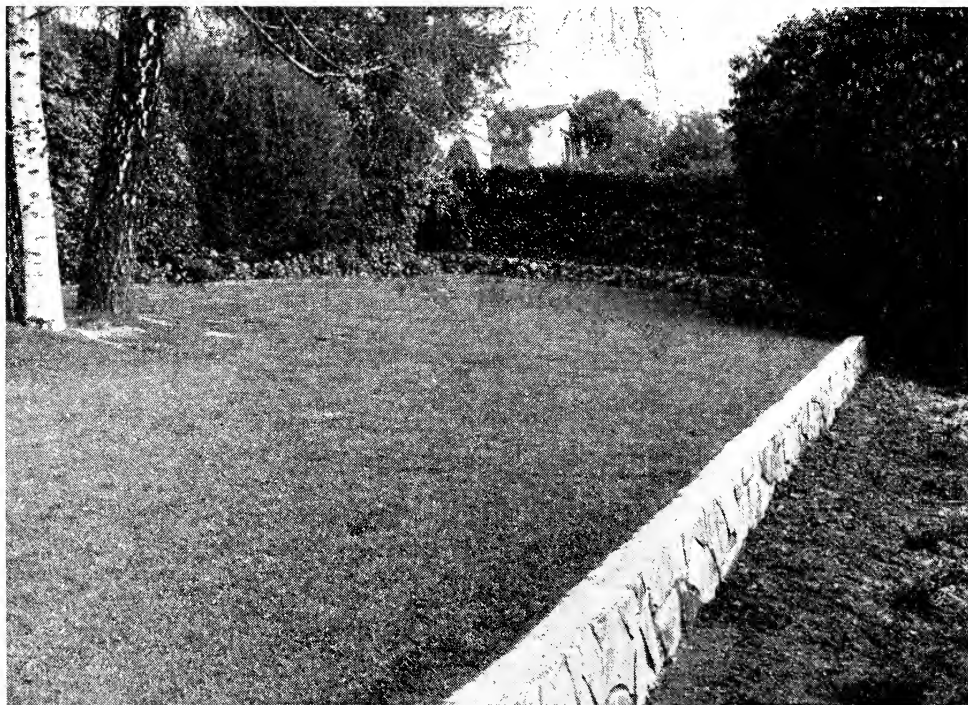
Fig. 5. A gradual and easy slope is needed for the modest home lawn.





narrow border of color, and espaliered apple combine for economy and simplicity. Fig. 4. One of many border effects set off well with a piece of lawn.

Fig. 6. A retaining wall decreases lawn slope and makes maintenance easier.



When a dwelling is slightly elevated from street level, a convex or mounded ground surface tends to lessen the structure's height; when low, a slightly concave surface gives it prominence (fig. 7).

California's semiarid climate seldom calls for a thick layer of crushed rock beneath level or gently sloping ground to assure the satisfactory drainage necessary to a good lawn.

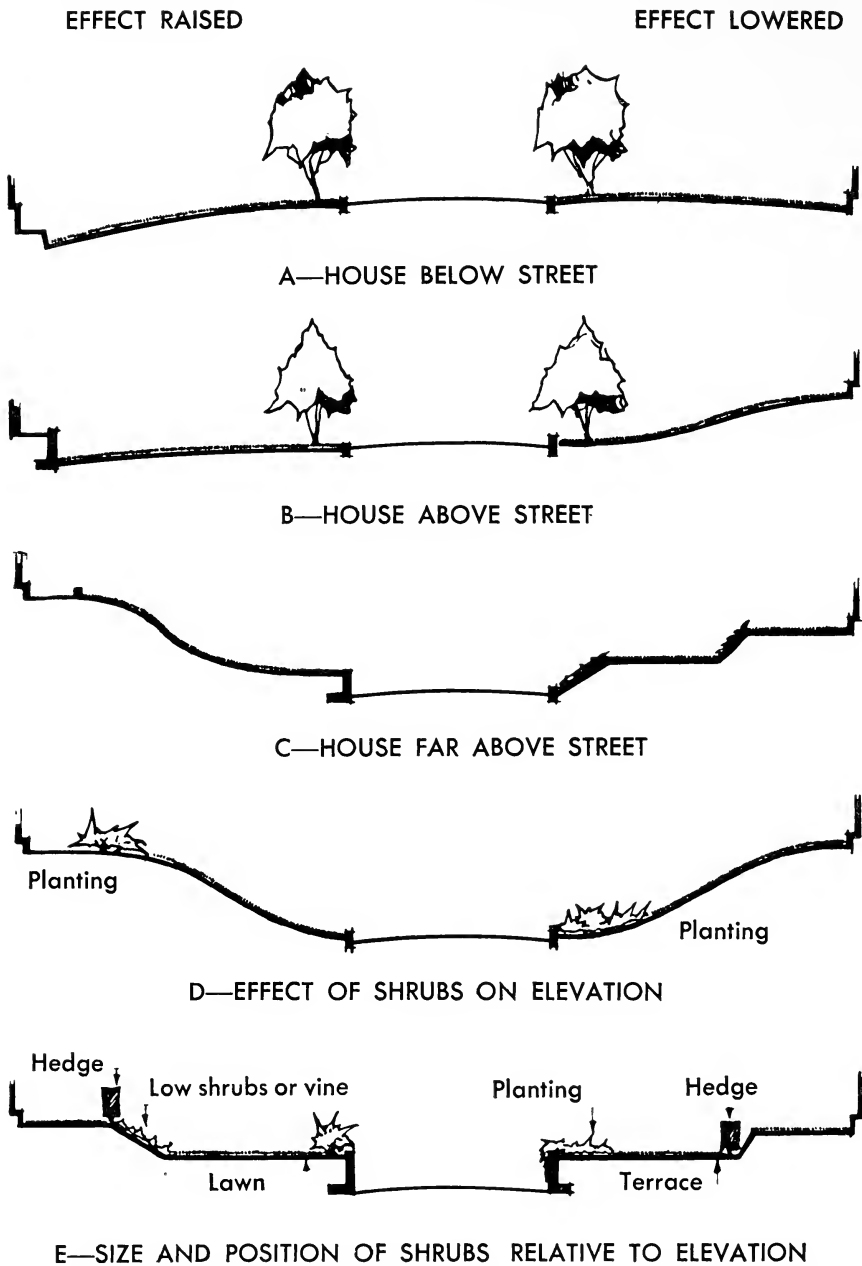


Fig. 7. A—E: At left, purpose of planting and grading is to raise apparent height of structure; at right, to lower apparent height. C illustrates position of retaining wall along street to raise apparent height of structure and also to lessen degree of slope. (Drawings by Jack Laffin, Lecturer in Landscape Architecture.)

Preparing the Seedbed

Grasses, if properly managed, will grow well on a wide range of soil texture (particle size), such as sand, loam, and clay. Somewhat coarser, more vigorous grasses may be required for the fine-textured (clay) soils than for loams or sands.

Saving topsoil. Any topsoil available from excavating or grading operations should be set aside for the surface of the lawn.

Hauling in topsoil. Many people dissatisfied with a too-clayey or too-sandy soil texture try to improve it by hauling in topsoil. Topsoil may be necessary in some special instances, but with initial soil improvement and good management, most soils can be made to grow satisfactory grass without the addition of topsoil. Topsoil is likely to be more effective for the improvement of very sandy soils than soils of finer texture. Topsoil used on clay soils should, itself, be relatively fine-textured.

Blend the lowermost layer of topsoil with the base on which it is used. This is done by spading, forking, or plowing. Unless this is done, the roots may be limited to the thin layer of topsoil. Any topsoil should of course come from a location of satisfactory natural vegetation, free from salt or other harmful minerals or debris.

Using subsoil. Even subsoil from excavations or soil whose structure was impaired by packing during building operations can, with satisfactory management, support as good a lawn as though topsoil were hauled in.

Preparation for planting should include certain tasks, some of which are performed gradually, others progressively.

Grading. Grade when the soil-moisture content is favorable, that is, when soil crumbles rather than packs. A soil too wet may puddle densely. One too dry may break down into a fine dust, a con-

dition usually worse than puddling. The soil should be worked as little as possible during grading. Fills should be left with the soil loose, and settled by watering rather than by mechanical packing.

Spading, forking, or plowing.

After grading, work the soil to a moderate depth (4 to 6 inches) by spading, forking, or plowing. Deep working is usually unnecessary. It may result in uneven settling, which will give a poor lawn surface. When preparing the soil, don't hurry the operation by breaking up clods mechanically, either by pounding with the spade or by using a rotating soil-beating tiller. Overworked soils tend to settle into a structure denser than normal, and are less satisfactory for plant growth.

Weathering. Slow weathering usually produces a good structure. During this process the soil settles gradually. The clods disintegrate from repeated wetting and drying, together with a moderate amount of cultivating or working at a favorable moisture content. At this state the soil should be dry enough to crumble rather than pack. When the soil is first worked, partially mix in manure or other readily decomposable organic matter. This will help the weathering process in developing a favorable structure. In addition, it will supply nutrients.

Settling. At some stage in preparing the seedbed, apply sufficient water to settle the surface.

Conditioning. Wetting and drying, especially when accompanied by applications of manure or of readily decomposable organic matter, often condition the soil satisfactorily, but sometimes so-called conditioners may be needed. Conditioners may be divided into three groups: 1) those that stimulate the biological processes; 2) those that have a chemical or physiochemical effect on the soil; and 3) those that are known as inert fillers.

The first group of soil conditioners is the most useful and includes such organic materials as manure, chopped alfalfa, organic compost, sewage sludge, and leafmold. These organic materials serve as food for microorganisms. During the decaying process the microorganisms produce certain types of organic chemicals that granulate the soil or develop a crumblike structure. Rapid decomposition of the materials quickly improves the soil.

A similar type of soil improvement can be produced by growing fibrous-rooted grasses. For instance, under very unfavorable soil conditions, good pastures have been produced by planting sudangrass first, taking off a crop of hay, then planting the finer grasses, clovers, et cetera in the sudangrass stubble. The sudangrass roots, together with substances produced during decay of the roots, change very unfavorable conditions to conditions suitable to establishing a pasture. By using a vigorous lawn grass rather than a sudangrass, this process may be useful in establishing a lawn on a tough soil. Any vigorous nonweedy crop if allowed to grow long enough to develop a good root system will greatly improve a soil.

The second group of soil conditioners includes so-called **agricultural minerals**, such as lime, gypsum, and sulfur, which are applied for a chemical or physiochemical effect. These materials usually are effective only when used to overcome a specific, unfavorable chemical condition of the soil. For example, if the soil is too alkaline, gypsum will probably markedly improve it—and gypsum is generally safer than sulfur for the amateur to use. For soil structure dense merely from packing or from an unfavorable claylike texture, gypsum is likely to have little, if any, value; whatever value it may have is from a temporary coagulation of the clay into a less sticky material. If the soil is too acid, it can be conditioned with lime. Too acid a soil is less

important for grasses, which are more acid-tolerant than is clover.

The third group of soil conditioners includes organic fillers, such as peat moss, which is practically inert and decomposes very slowly, and mineral fillers, such as vermiculite, pumice, perlite, scoria, and sand. These materials have no chemical effect; they do not alter the stickiness of the clay nor develop the necessary crumblike structure of the soil. They merely dilute the soil without blending with it. Their effect on available water supply has been greatly overexaggerated. They will not be helpful for any purpose unless used in relatively large quantities. Usually the same amount of money invested in decomposable organic materials will give greater improvement of the soil.

Leveling. This is a gradual process through raking, cultivating, or through minor grading operations performed while the weathering, settling, and conditioning practices are going on.

Germinating weeds. Weed seeds can also be germinated during this particular period, and the weeds themselves removed during the final leveling. Well in advance of planting, weedy perennial grasses should be killed by tillage or by such sprays as maleic hydrazide and TCA. The soil should not be worked more than is absolutely necessary for this final evening-up, because each working tends to impair rather than to improve the structure. Rolling the seedbed may not be necessary before planting if the soil is given sufficient time for settling, although rolling does tend to break up the small clods beneath the surface of the bed.

Completing the seedbed. In the final preparation of the seedbed, loosen the soil to a depth of about one-half inch and break it into fine particles with a rake or with small cultivator teeth. If the soil is loosened to a greater depth, it will have to be settled again. The bed is now ready for planting, which process is described in the section "Planting the Seedbed," on page 24.

Planning for Irrigation

Most California lawns must be watered from April to October. This calls for a practical system of irrigation. Hand irrigation is not as satisfactory as a good sprinkler system because few gardeners will hold a hose long enough at one time for the water to penetrate to a satisfactory depth. With an efficient sprinkler system, the sprinklers can be turned on at any time and left to operate until the lawn is adequately watered. In this way, many hours of maintenance can be saved.

Many important decisions must be made when considering the installation of a sprinkler system. The type of system, amount of water pressure, choice of heads and length of connecting nipples, spacing of heads, and kind and size of pipe are all of great importance to any sprinkler system.

Selecting the sprinkler system.

The system should fit the family income as well as the lawn's needs. For a small lawn, an underground system with fixed heads is generally the most satisfactory. Some gardeners use a sprinkler head that rises when the water is turned on and settles back when the water is turned off. This type is out of the way of the lawn mower. For very large areas, rotary sprinklers that can be quickly attached or removed are practical. There is a specific type of sprinkler for almost every lawn plan.

Determining water pressure. The size of the pipe connecting a house with the street side of the water meter determines the water pressure in the garden. Many houses are connected on the street side of the meter with only half-inch pipe. In addition to pressure control by pipe size is further control by the bur which may have been left on the inside of the pipe by the roller pipe-cutter. The original inside diameter of the pipe can be restored only by using a reamer to remove the bur. All joints and nipples must be sealed against leakage. In cutting pipe,

use a hacksaw, which cuts without leaving a bur, rather than a pipe-cutter.

Inadequate water pressure is commonly caused by too many sprinkler heads to one shut-off valve. In some cities the pressure is not adequate for more than 5 or 6 sprinkler heads to half-inch-pipe connection. If the size of the laterals can be increased to $\frac{3}{4}$ -inch pipe, and the main line to 1 inch or to $1\frac{1}{2}$ inches or more, the pressure should be much greater. The larger diameter must extend beyond the meter to the main pipe.

Anticipating that the shut-off valve might have to be replaced or repaired, a union joint should be installed next to each shut-off valve. This will eliminate the necessity of cutting the pipe with a hacksaw and replacing with a union joint later on should replacement be necessary.

On farms where water pressure is low, pipe should be of fairly large diameter, with suitable sprinkler heads spaced at carefully measured distances to give adequate coverage of the lawn. Good sprinkler-head pressure is needed where general pressure is low.

Choosing sprinkler heads and nipples. Several styles of sprinkler heads are on the market, with the best durable and easily adjusted. Only enough sprinkler heads should be connected with each shut-off valve to give the desired pressure when the water pressure is at its lowest point during the day. By drawing the lawn plan to scale, the sprinkler system can be laid out accurately and the number and kind of heads determined in advance.

Many of the popular small heads cover a circle about 12 feet in diameter with adequate pressure. By setting the heads 10 feet apart, with 20 to 25 pounds pressure, the water from one head will overlap the next head part way, insuring an even coverage. Sprinkler heads in one row should be set half way between the heads in the next row, so that the water

circles fit well into each other. Sprinkler heads to cover a half circle or a quarter circle are available; the quarter circle, however, does not always function as well as the half and the full circles. Half circles are placed along the edges of the lawn or bed, and quarter circles at the square corners.

When water pipes are laid on a slope, remember that after the water is turned off, it will run out of the lowest sprinkler head until the pipe is emptied. If the line of sprinkler heads is laid as nearly level as possible, there will be very little water left in the lower end of the pipe line to cause erosion.

The exact length of the individual nipples connecting the sprinkler heads is hard to determine until the soil has settled after planting. Some contractors put in temporary nipples, with the sprinkler heads standing well above the lawn surface. As soon as the soil has settled, the

sprinkler heads are installed at a level to clear the lawn mower. Nipples come in various lengths; this makes it possible to buy the right length and not have to cut and thread them at home. Shorter nipples save trouble and labor.

Using durable pipe. In the last few years, durable galvanized pipe has been scarce on some markets. Reconditioned pipe is sometimes used. Copper pipe is also used, when available. Some water districts greatly increase the life of the pipe by treating the water with lime to reduce electrolysis in the pipes. Treating pipe with hot tar before it is laid also helps to lengthen its normal life.

Lay underground pipes several weeks before planting so that the soil will have time to settle. Pipes can be laid in established lawns by lifting the sod carefully with a sharp spade, then replacing the sod after the pipes are down. If this is done, the entire pipe should be treated.

Knowing the Grass Species and Varieties and Their Characteristics

Some knowledge of grass characteristics is needed in selecting a specific grass or grass mixture. Four important points must be kept in mind: 1) climate and exposure; 2) soil; 3) maintenance, including watering and mowing; and 4) lawn use.

A seed mixture including both a warm-season and a cool-season grass will meet the requirements of climate and exposure in California. This combination will produce a lawn that, under normal variation in climate and with good management, will be green the year round.

Soil requirements can be met only if the needs of the specific grass or grass mixture are known. All grasses benefit by fertile soil and good drainage. Some grasses are more drought-resistant than others; and some stand more alkali or more acid than others. Where only deficient or thin, worn-out soils are available for planting, it is important to know what

soil conditioners will help to restore them.

A grass or a grass mixture should be able to form a good turf and crowd out weeds; it should also be free from diseases and pests. Adaptation of the grass will save much labor in maintenance.

A lawn to be used as a service yard or playfield, or for any purpose involving heavy tramping, must be able to stand up under traffic. Surface compaction of the soil will result from hard usage.

A summary of the specific characteristics of certain grasses for certain conditions in California indicates that Kentucky bluegrass and Colonial bent, in their best strains, are perhaps two of the most satisfactory. The Illahee strain of creeping red fescue does better than Kentucky bluegrass in shade and tolerates soil of lower fertility and with less moisture. Kentucky bluegrass and creeping red fescue make a good mixture. Chart 1 lists many of the grasses and their needs.

Bluegrass (*Poa species*). The dense and extensive root system of Kentucky bluegrass (*Poa pratensis*) (fig. 8) probably accounts for its long-lived and hardy characteristics. Under most garden conditions, the foliage is dark blue-green and of medium texture, not quite so fine as good bentgrass but better than its relative *Poa trivialis*. It can be planted with ryegrass or with white Dutch clover where a mixture is desired. It does not remain so green in cold winters as ryegrass. Its sod should become well established in 6 months to a year. The grass spreads by underground rootstalks or rhizomes, much like Colonial bents. Under favorable conditions, Kentucky bluegrass has lived for twenty years or longer.

Climate and exposure: Bluegrass will stand cold, heat, and some drought, but will not tolerate much shade. The grass is fairly dormant in December and January; for this reason, some gardeners prefer to use it in a mixture with other grasses that are green in winter.

Soil: Fertile, well-drained soils of neutral or slightly alkaline reaction are best for bluegrass. The soil should contain a liberal amount of phosphate. *Poa pratensis* is not well adapted to thin, worn-out, acid, or infertile soils.

Maintenance: Bluegrass should not be watered as often as creeping bent. It does not require such frequent mowing as bentgrass, and should not be clipped closer than 1½ inches. If neglected for a time, it will usually recover very well under good management.

Lawn use: Bluegrass is tolerant of tramping after it has formed a good sod.

The Merion (B-27), a variety of Kentucky bluegrass, has been tested in recent years and appears to be superior to ordinary bluegrass in turf quality, color, and

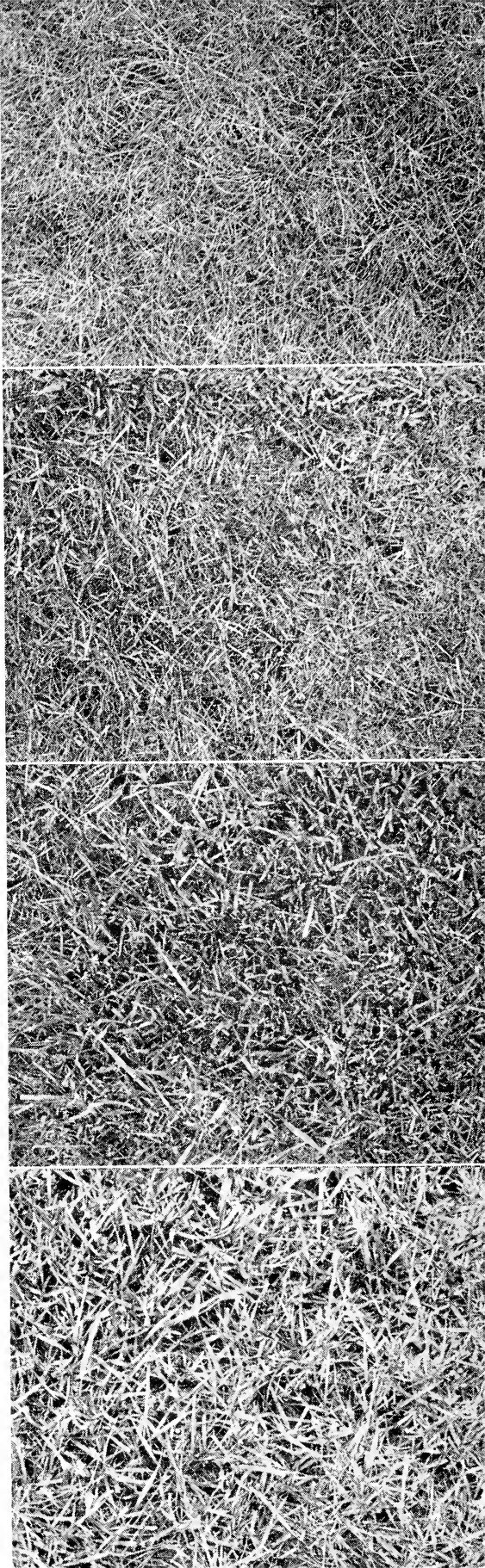


Fig. 8. Gradation of grass texture from fine to coarse is illustrated by the four grasses shown from top to bottom in this panel: creeping red fescue, Kentucky bluegrass, perennial rye, and meadow fescue.

resistance to leaf spot. It makes a dense turf, takes closer mowing and less mowing, and is more resistant to the invasion of other grasses and weeds than the usual bluegrass. The supply of Merion (B-27) seed is still so scarce that few home gar-

deners are able to find it in nurseries or seed houses.
 Rough (stalk) bluegrass (*Poa trivialis*) is used in most shade-grass mixtures. The grass is a bright yellow-green rather than the dark green of Kentucky

Chart 1. A listing of some popular

	Climate needed	Shade tolerance	Soil and fertility preference
Bentgrasses (<i>Agrostis</i> species) A. tenuis varieties Colonial bent Astoria bent Highland bent Creeping bent (<i>A. palustris</i>) (Seaside, Cocos, Washington, Metropolitan, et cetera) Redtop (<i>A. alba</i>) Velvet bent (<i>A. canina</i>)	cool and moist cool and moist cool or hot warm or cold	very good very good medium poor	well-drained acid loams; low-to-medium fertility acid loams; best with high fertility wide range; best when fertilized well-drained fertile loam well-drained fertile loam; tolerates some alkali
Bermudagrass (<i>Cynodon dactylon</i>)	mild to hot	poor	well-drained fertile loam; tolerates some alkali
Bluegrasses (<i>Poa</i> species) Kentucky bluegrass (<i>P. pratensis</i>) (fig. 8) Rough bluegrass (<i>P. trivialis</i>)	warm or cold cool and moist	medium to poor very good	well-drained fertile loam; neutral or alkaline slightly acid; best in fertile loam
Fescues (<i>Festuca</i> species) Chewings fescue (<i>F. rubra</i> var. <i>fallax</i>) Creeping red fescue (<i>F. rubra</i>) (as Illahee and Ranier) (fig. 8)	warm or cool cool and moist	good good	wide range; sand or loam; medium fertility sand or loam; medium-to-high fertility
Ryegrasses (<i>Lolium</i> species) Domestic rye (<i>L. multiflorum</i>) (Italian, Pacific) Perennial rye (<i>L. perenne</i>) (fig. 8)	cool or hot cool or hot	medium to poor good to medium	well-drained heavy soil; medium-to-high fertility well-drained heavy soil; medium-to-high fertility
Matrellagrass (<i>Zoysia matrella</i>) (Flawn)	cool and moist	medium	well-drained heavy soil; medium fertility
White clover (<i>Trifolium repens</i>) (fig. 11)	warm	medium	well-drained loam; medium fertility

* L = long; M = medium; S = short.
 † 15-20 lbs. stolons to 1000 sq. ft.

bluegrass. It does best in a soil of neutral or slightly alkaline reaction, which contains a considerable amount of lime. It spreads by runners or stolons.

Poa trivialis is not well adapted to very sunny areas nor to very hot weather (90°

F or above), but makes a fine turf in shaded lawn areas. It seldom needs a nurse grass unless seeded at a time when perennial grasses are hard to start.

Ryegrasses (*Lolium species*). Three kinds of ryegrass are listed by dealers.

lawn grasses and their needs

Water needed	Care required	Texture	Color and period when green	Life*	How started†	Germination	Rate of seeding, 1 lb. to no. sq. ft.
good supply, but Highland bent drought-tolerant	much	fine	light green spring to fall	M	seed or stolons	medium	500
good supply	much	fine	lighter than Astoria bent; spring to fall	M	seed or stolons	medium	500
good supply, but drought-tolerant	medium	coarse	pale to bluish green; best in late summer	S	seed	rapid	500
good supply	much	very fine	dark green; spring and summer	M	seed	medium to slow	1000
good supply	medium	fine	dull green; summer to fall	L	seed	good when warm	500
good supply	medium to much	medium	bluish green; summer to fall	L	seed	slow	350
good supply	medium to much	fine	bluish green; spring to fall	M	seed	medium	350
little or much	medium to much	fine	dark green; spring to fall	M	seed	medium	250
good supply	medium to much	fine	deep green; spring to fall	M	seed	medium	250
drought-tolerant	medium to much	medium coarse	deep green most of year	1 yr.	seed	rapid	200
drought-tolerant	medium to much	medium coarse	dark green most of year	M	seed	rapid	200
good supply	medium	fine to medium	medium green; summer to fall	M	sod	poor	...
good supply	much	coarse	light green; spring to fall	S	seed	good and rapid	2 oz. per lb. grass

these are perennial rye (*Lolium perenne*) (fig. 8); Italian rye (*L. multiflorum*); and domestic rye (*L. multiflorum* variety). It is often used as a nurse, or companion grass, with Kentucky bluegrass or white Dutch clover, where a mixture is desired, but it is not the best companion grass. Ryegrass gives a quick effect and stands much abuse.

Perennial rye is sometimes sold under various strain names, such as Australian rye and Pacey's rye, but the ordinary perennial rye is best. In California it should grow well for at least four to five years under favorable conditions. In the coastal areas some perennial ryegrass lawns have done well for twenty years.

Climate and exposure: Perennial rye can be sown at a season when some of the popular perennial grasses start poorly. Its quick-forming, dark-green cover remains greener in cold winters than some of the popular lawn grasses, such as Kentucky bluegrass. It tolerates more shade than Kentucky bluegrass, yet stands considerable drought, even surviving on a hot slope where some other grasses would fail.

Soil: Perennial ryegrass prefers well-drained, heavy soil of medium-to-light fertility.

Maintenance: Frequent watering is not as urgent with ryegrass as with bentgrass, although ryegrass will respond to good care. All ryegrass is coarse and unless it is mowed at least once a week during the growing season, it soon sends up tough seed stalks that interfere with mowing.

Lawn use: The best strains of perennial rye are useful for planting in service yards or in large areas where little soil preparation or care is given. A 50 per cent mixture of perennial ryegrass and roughstalk bluegrass, sown at the rate of 1 pound for 150 square feet, stands some abuse and drought and matures quickly. It will also tolerate some shade.

The two varieties Italian rye and domestic rye are similar to perennial rye-

grass, but do not live so long and have little to recommend them for garden lawns. Domestic or common ryegrass is a variety of Italian ryegrass which includes both annual and perennial forms. It has largely replaced the regular Italian ryegrass as a house grass in lawnseed mixtures. Its length of life is short. Some of the hardy grass mixtures offered for sale in California contain up to 60 per cent domestic ryegrass.

Bentgrasses (*Agrostis* species). At least four species of bentgrasses are worthy of mention: redtop (*Agrostis alba*), which is sometimes known as English bent, Southern bent, and Herdsgrass; Colonial bent (*A. tenuis*), which includes the three main varieties or strains—Astoria, Highland, and Colonial—, Rhode Island bent, Common bent, Oregon bent, and New Zealand bent; Creeping bent (*A. palustris*), sometimes referred to by the names of Seaside bent or Cocoos bent, Washington bent, and Metropolitan bent; and Velvet bent (*A. canina*). Various strains or varieties may occur within these species. When buying Colonial bent seed, specify the variety wanted, such as Astoria or Highland.

Some bents are more subject to disease and lawn insects than are the fescues, bluegrass, or ryegrass. Bentgrasses like a cool, moist, coastal climate, and need frequent watering. Both bents and fescues will tolerate much more shade than bluegrass, with the exception of *Poa trivialis*.

The hardy, coarse-textured redtop spreads by shallow, underground rootstocks from 2 to 6 inches in length. The decumbent stems often root at the base. The color of its rather coarse leaves varies from pale to bluish green. The grass establishes a turf rather quickly and is fairly enduring.

Redtop is often included in mixtures for service yards or other areas where conditions are not very favorable for the best grasses, although it is being replaced by better companion grasses. It is used

up to 30 per cent in a mixture with Kentucky bluegrass, perennial ryegrass, fine-textured fescues, and white clover.

Climate and exposure: Redtop stands extremes of heat and cold or sudden changes in weather. It is drought-enduring.

Soil: Redtop can be planted in almost any kind of soil, even thin, acid, or poor soil, but it naturally does best in good loams. It responds well to good care, especially to fertilizing. It needs excellent drainage from the start, although it will stand wet feet much better than most grasses.

Maintenance: In spite of its drought-tolerance, redtop requires frequent watering. It also requires frequent mowing.

Lawn use: Bentgrasses are not as tolerant of tramping as bluegrass.

Astoria bent is one of the most popular of all the varieties for home lawns. Like the Highland variety, it spreads both by surface runners and underground rhizomes. Its growth is not usually as upright as the Highland variety, but frequently it has finer-textured leaves and stems than the other forms. It is usually somewhat shallow-rooted. Its requirements, like most bents, are exacting, and if growing conditions are not favorable, it may be readily attacked by sod webworm and brown-patch fungus. Given good drainage and plenty of water, Astoria bent is one of the very best of the lawn grasses.

The stems of Highland bent are usually somewhat more upright than other bents, although not usually as tall as Astoria. In spite of the fact that its fairly extensive root system has given it the reputation of being the most drought-resistant of the bents, it does need a good supply of soil moisture. In winter, Highland bent seems to hold its green color a little better than do the other bents.

Colonial bent represents all the other forms of *Agrostis tenuis* not included under the names of Astoria and Highland, such as Rhode Island bent—the smallest

stemmed and most delicately foliated of bents; Australian Browntop; and some strains of German bent.

The two similar but distinct types included in creeping bent are sometimes listed as inland and seacoast forms. The latter is represented by Seaside bent or Cocoos bent (formerly listed as *A. maritima*). The coastal form is somewhat more luxuriant and coarser than the inland and has fewer but broader and stouter stems. Seaside bent has numerous fine, overground, trailing, leafy stems that take root. The stem leaves are usually flat and narrow. A good sod can be expected in a year. Seaside bent, usually confined to coastal areas where the humidity is higher and the air is cooler than inland areas, needs a liberal supply of water.

Clonal strains of creeping bent, particularly Metropolitan and Washington, are propagated vegetatively for lawn planting. The texture of the different forms varies greatly. The color is bluish to green.

Velvet bent is the finest textured of all the bents. It grows under about the same conditions as Kentucky bluegrass. Like the other bents, it does well in acid soil. It tends to mat more than most of the other bents, so requires grooming and raking to insure proper water penetration. At least three varieties of Velvet bent have been mentioned: Kernwood, Piper, and Raritan.

Velvet bent seed is the most expensive per pound of all bent seeds, but its tiny size makes a small amount go a long way. The seed is not always available or may be scarce, which makes it high priced. Some gardeners propagate the variety by stolons. It creeps extensively and roots at the lower nodes where moisture and soil conditions are favorable. Some of the best grass mixtures contain small amounts of Velvet bent seed.

Unless gardeners have excellent growing conditions and are prepared to give the new plantings of Velvet bent proper

care, Astoria and Highland will probably be more satisfactory for the average garden lawn. Given satisfactory conditions, however, Velvet bent will have the best quality of all the bents.

Superior strains of creeping bents are being tested, such as Arlington, Old Orchard, and Congressional, but seed is not yet available commercially to the home gardener.

Fescues (*Festuca species*). Useful in grass mixtures, the fescues are less particular about soil conditions than either bentgrass or bluegrass. They thrive in soil slightly acid or slightly alkaline, even grow on rather poor, sandy soils where many other lawn grasses fail. They grow best on good soil, of course, and with more than ordinary care. There is a great deal of variation in the value of the different kinds of fescues, insofar as lawn purposes are concerned, and the selection should be made carefully if fescues are to be entirely satisfactory.

Creeping red fescue (see figure 8), a selection of red fescue (*Festuca rubra*), forms a fine turf of wirelike leaves. It spreads by underground rhizomes, which favor a tight sod. Creeping red fescue is often mixed with Kentucky bluegrass for planting in gardens where the lawn will receive only ordinary care. This lawn grass holds its color very well during hot weather—superior to Chewings fescue in this characteristic. It also grows in shade. It will stand cold weather, and is able to grow in relatively poor soils, requiring little moisture and standing up well under traffic.

The Illahee variety of creeping red fescue is superior to other strains. It is somewhat higher priced than the ordinary creeping red fescue. It is often sown with other permanent grasses and sometimes with a nurse grass. This strain has been recommended where the lawn will receive heavy tramping and where there is some shade.

Chewings fescue (*Festuca rubra* var. *jallax*) is known to produce a turf of wire-

like leaves, and does not stool out like the other fescues. It makes a good, matted turf in time, and is able to crowd out some kinds of weeds. This variety does best on well-drained soil of not too high fertility, and seldom needs water except in the very dry months. Frequent mowing produces the most satisfactory turf. If a single plant is allowed to spread out and occupy a broad area the grass will be hard to cut. The best texture can be expected when the stand is good. It is dark green from spring to autumn.

Chewings fescue is now being superseded to some extent by superior grasses, such as the Illahee variety. The Ranier strain seems better than the regular stock of Chewings fescue. The Pennsylvania State Chewings fescue has an excellent reputation. In spite of the recommendations of new strains of red fescue, the worth of Chewings fescue has been proved by field tests of many years' standing. A field of 15 acres was prepared for the sowing of an equal number of seeds of several commonly used grasses. After being under observation for seven years, Chewings fescue was seen to predominate.

The value of new strains may be determined only after normal usage over a long period. It is better to continue to use grasses known to be satisfactory than to turn to so-called improved strains highly recommended by a commercial enthusiast. It is also true that highly heralded grasses from certain regions of America have not entirely lived up to their advance notice in some California areas when normal irrigation practices were followed.

Meadow fescue (*Festuca elatior*) (see figure 8), valued mostly for pasture, is included in some Golden Gate mixtures, where it makes up perhaps 20 per cent of the total mixture. It is a good nurse or companion grass. It does not throw out rootstalks or stolons, so a plant may become coarse and bunchy in time—somewhat like certain of the ryegrasses. Since it stands wet soil fairly well, meadow fes-

cue may find a place in service yards that are wet for several weeks in winter.

Meadow fescue has been listed incorrectly at times as English bluegrass, but should not be confused with either bluegrass or red fescue.

Alta fescue (*Festuca elatior* var. *arundinacea*) is a popular pasture grass receiving some attention in California for playgrounds and service areas because it stands heavy tramping. Its coarseness, however, is not recommended for areas where the bentgrasses, bluegrasses, and fescues thrive and make a better appearing lawn under favorable conditions.

Alta fescue will stand either wet or dry conditions and either acid or alkaline soil. It stands poor topsoil, little watering, and is disease-resistant. When mowed, it should not be cut lower than 1 inch. It is greenest during the spring and summer. Normally, if the soil is well drained, Alta fescue is long-lived.

Some gardeners when planting Alta fescue on moist, heavy soils prefer to use redtop and perennial rye as a companion crop. In mixtures, Alta fescue can be used at the rate of 50 per cent, along with 25 per cent red fescue and 25 per cent Kentucky bluegrass.

Miscellaneous lawn grasses. Bermudagrass (*Cynodon dactylon*) was first brought to California in 1856, and the common strain has been widely known as a weed pest. Many people living in the warm interior valleys near open irrigation ditches find that Bermudagrass will come into a lawn sooner or later, so plant it at the start of the lawn and try to keep it in good condition. The common variety is green only during the warmer months of the year and turns brown in cold weather.

In recent years, strains of Bermudagrass have been selected that promise a greener color during cool weather. U-3 is one of these strains. It is only slightly discolored in the coastal area of southern California in late December. It retains its green if given nitrogen in the fall. The

U-3 strain has not been observed to set seed. Stolons or plugs of sod are available at present only in limited supply in California, but should be available generally in a few seasons.

Since the grass spreads rapidly by rhizomes it should be confined to prevent its spread into nearby beds or around shrubs and other plants. If Bermudagrass is already established, there is little use in trying to grow other grasses until it is exterminated. Sometimes in the fall the turf is closely cut with a special tool that loosens the soil, and perennial ryegrass or some other companion grass is planted for its green color during the winter months. When the Bermudagrass starts to grow in the spring it will again assert itself and dominate the lawn.

Bermudagrass has also been sown in a young lawn of perennial ryegrass, where white clover may be present, with the intention of having Bermudagrass ultimately take over the entire lawn. The ryegrass and clover are planted in the fall, and the Bermudagrass seeds are sown and raked in after the weather warms up in the spring. Similarly, Kentucky bluegrass and Highland bent may be seeded in with Bermudagrass.

Weather that is warm-to-hot is best for Bermudagrass. Its permanent sod stands much drought, although it responds to good care and a good supply of water. Bermudagrass will stand much tramping and abuse.

Kikuyugrass (*Pennisetum clandestinum*) (fig. 9) is a very coarse grass that rarely sets seed in California. It is started from stolons or plugs of sod. It resembles a very coarse Bermudagrass lawn in its hardness and growth. It sends rhizomes down to a depth of several inches. Kikuyugrass can become a serious weed.

Its coarse texture and yellowish-green foliage are objectionable to many people, yet this grass will remain exceedingly vigorous under somewhat adverse soil conditions and a great deal of tramping. It is very springy, takes frequent mow-

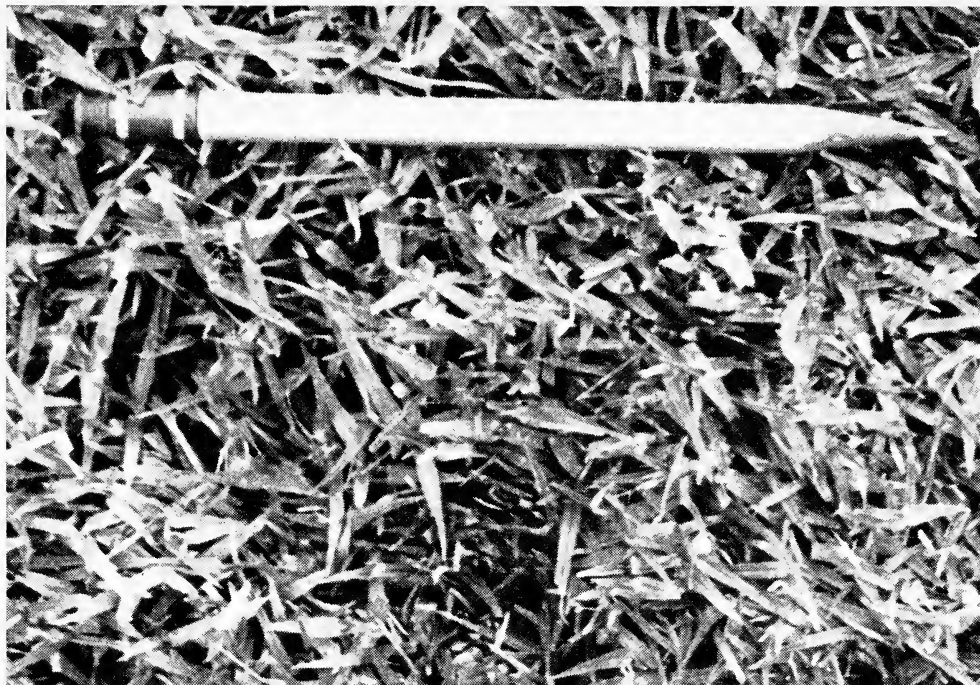


Fig. 9. The vigorous Kikuyugrass is very coarse in texture.

ing and, occasionally, very close mowing to prevent matting. If allowed to make much growth it cannot be mowed easily with a hand mower. Trim the edges regularly to keep the grass from spreading to nearby areas.

St. Augustinegrass (*Stenotaphrum secundatum*) is not suitable where a fine-textured lawn is planned. It closely resembles kikuyugrass in coarseness, vigor, and need of mild temperatures. In southern states like Florida, where it is one of the best grasses for shady locations, it is very popular. In California it grows in either sun or shade.

St. Augustinegrass is started from plugs of sod in California. Seed is not available. Its ability to stand hard usage makes it suitable for service yards or playgrounds, but its springy nature demands occasional close cutting and grooming to prevent surface matting. It should be confined wherever it is grown.

When St. Augustinegrass is a weed, it can be killed by tillage and by chemical

sprays, such as maleic hydrazide, but this chemical is not selective.

Zoysia occasionally is grown in California in three species: *Zoysia japonica*, *Z. matrella*, and *Z. tenuifolia*. The seed of the zoysia grasses is scarce and that produced sometimes fails to germinate. If a way can be found to improve seed germination, *Z. matrella* may have a place in areas of mild winters. Soaking the seed before planting sometimes improves germination. Seed germinates best at fairly high temperatures—up to 95° F.

Zoysia japonica, known as Japanese lawnglass, develops an extensive, tough root system. The most winter-hardy of the three species, it will, nevertheless, turn brown or straw-colored with the first heavy frost. It can replace Bermudagrass in warmer areas, but usually has to be started from plugs of sod. Being very slow to mature, it has limited possibilities. Once established, however, it is hardy and persistent and requires very little cutting. *Z. japonica* stands much tramp-

ing and can be combined with Kentucky bluegrass for planting in service yards or play areas where hard usage is expected. It is a little coarser than bluegrass.

Zoysia matrella (Manilagrass; flawn, a strain) is the most important and widely used of the zoysias, but is not quite so winter-hardy as *Z. japonica*. It does best on the heavier soil types and will tolerate some shade. It seems to be resistant to attack by both diseases and insects. In California, *Z. matrella* is started from sod and is slow to mature. Once established, however, it tends to crowd out other grasses until it dominates the lawn. Its texture is finer than that of Japanese lawngrass and bluegrass. It needs less frequent mowing than most other grasses, and should be planted alone. *Z. matrella* needs a good supply of water.

Zoysia tenuifolia (Mascarenegrass, velvetgrass) has been planted occasionally for more than thirty-five years, but it has never met with much popularity. The grass is very dark green. It is the finest-textured of all grasses, and so short—not more than 2 inches—that it does not have to be mowed. Some strains develop humps and ridges in time and this fact, together with the scarcity of sod, probably ac-

counts for its lack of popularity. Unless some way can be found to prevent its forming humps, *Z. tenuifolia* will probably never be planted extensively.

Centipedegrass (*Eremochloa ophiuroides*) is a Chinese grass. Suitable only for areas with mild weather, it is planted in the southeastern states. It will tolerate some drought, but will not withstand winter freezing. Claims that it is able to fight its way with Bermudagrass are not at all reassuring to gardeners who have had trouble with Bermudagrass and similar weedy grasses. Unless centipedegrass can be confined in some satisfactory way, it has little to recommend it, even in the mild parts of southern California.

Tests have not progressed far enough in California at this time to make any final approval of its value as a lawn grass.

Mitchellgrass (*Astrebla* species) is a drought-tolerant grass limited to parts of southern California because it will not withstand winter freezing. It might be tested for service-yard areas, where little care is to be given to the grass. However, it is not so widely adapted as some other grasses, including centipedegrass. Mitchellgrass does not require regular mowing.

Selecting the Seed

With some knowledge of grass seeds and seed mixtures the gardener will need to find a dealer who is known to sell seed that has given good results. Seed companies that have carefully studied the reasons for combining certain seeds in mixtures and that use grasses known to thrive under specific conditions will usually enjoy the confidence of both gardeners and retailers.

Grass seed should be selected from recent-crop, re-cleaned, Grade-A seed of high germination, free from noxious weed seeds. There are standards of seed purity and germination, which reputable seedsmen endeavor to follow closely. The original package is labeled to show the

percentage of purity and germination. For example, most of the grasses will indicate at least 85 to 90 per cent germination.

A mixture of grass varieties adapted to local conditions may thrive better than any one grass alone. The faults of a variety may not be as conspicuous in a mixture as when planted alone. Mixtures are prepared in the expectation of producing a green lawn during most of the year. Regardless of the uniformity of sowing, it is reasonable to expect one grass to predominate, thereby changing the texture of the sod. This natural survival determines the best choice for uniform stands. In spite of the advantages

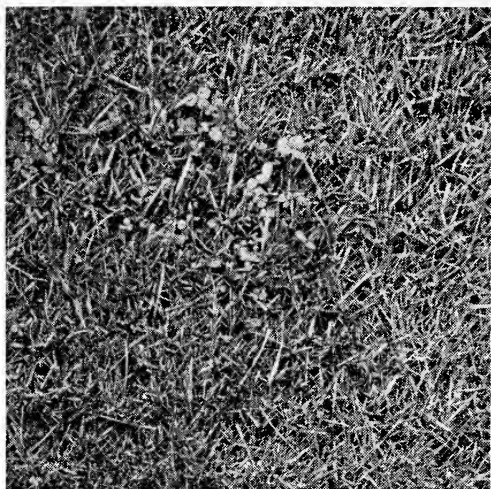


Fig. 10. One of the popular grass mixtures used in this state is California Lawn Mixture.

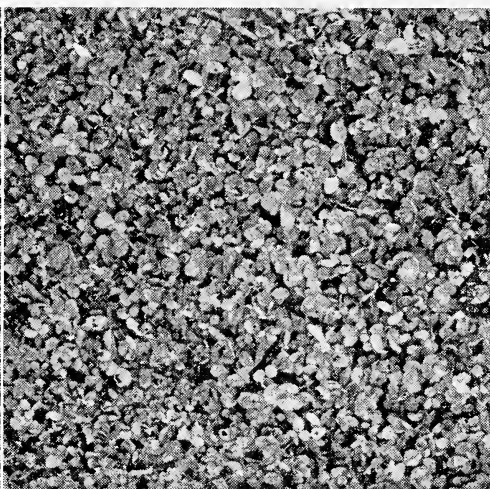


Fig. 11. White Dutch clover is planted alone in this lawn.

of the mixtures there is no more effective lawn than one with a single grass favorably established and properly maintained.

Using the commercial mixture.

Most seedsmen offer various mixtures of lawn-grass seed. Selection of seeds should be based on climate and exposure, soil and moisture, maintenance, usage, and any other conditions that may affect the success of the turf.

Grass-seed mixtures are sold under a variety of names. These include Golden Gate Mixture, Choice Golden Gate Mixture, Hardy Lawn Mixture, California Lawn Mixture (fig. 10), Shady Grass Mixture, and with names suggesting some

green mixture. The beginner should know enough about such mixtures to select wisely or take the seedsman's advice.

White Dutch clover is sometimes planted alone (fig. 11) and is often added to the cheaper mixtures, such as Golden Gate Lawn Mixture, or may be planted with perennial ryegrass.

Preparing the mixture at home.

The gardener rarely knows exactly what goes into the commercial mixtures. Not wanting to plant a seed mixture of unknown composition, he may decide to prepare his own mixture. Then he needs to know what seeds to combine. Chart 2 contains examples of grass mixtures.

Safeguarding the Seed with Fungicides

Certain harmful fungi thrive in cold, poorly drained, wet soils. These organisms often cause poor seed germination. There are two safeguards against them.

Planting ahead of cold weather.

By planting early enough in the fall, the young grass will be well up before cold weather sets in. In many areas the end of September or early October is not too late. Early planting is especially advisable

when the home owner does not want to wait until warm spring weather.

Treating seeds with fungicides.

Treating the seed with fungicides before planting gives some protection against fungus trouble. Sperguson W (wetttable), Tersan, Cadminate, and other fungicides have been used to help protect against damping-off fungus. For each 1,000 square feet, allow about 5 ounces of

Chart 2. Examples of grass mixtures

Mixtures	Per cent by weight	1 lb. per number sq. ft.
Listed as choice:		300
Perennial ryegrass.....	50	
Kentucky bluegrass.....	30	
Meadow fescue.....	15	
White Dutch clover.....	5	
	<u>100</u>	
Similar, with more ryegrass:		300
Perennial ryegrass.....	60	
Kentucky bluegrass.....	20	
Redtop.....	15	
White Dutch clover.....	5	
	<u>100</u>	
Hardy:		300
Domestic ryegrass.....	60	
Meadow fescue.....	20	
Kentucky bluegrass.....	20	
	<u>100</u>	
Fine-textured:		350
Kentucky bluegrass.....	50	
Chewings fescue.....	25	
Astoria bluegrass.....	25	
	<u>100</u>	
Fine-textured:		500
Astoria bentgrass.....	65	
Seaside bentgrass.....	30	
Velvet bentgrass.....	5	
	<u>100</u>	
Service yard, for northern California:		300
Perennial ryegrass.....	40	
Illahee fescue.....	25	
Kentucky bluegrass.....	20	
Redtop.....	15	
	<u>100</u>	
Shady lawn, for northern California:		300
Creeping red fescue.....	50	
Rough bluegrass.....	30	
Redtop.....	20	
	<u>100</u>	
Temporary ground cover for summer sowing:		300
Redtop.....	50	
White Dutch clover*.....	50	
	<u>100</u>	

* May be sown separately at $\frac{1}{2}$ lb. per 300 sq. ft.

Tersan, 3 ounces of Cadminate, or 3 ounces of Spergon. Spergon is used at the rate of 1 ounce for 10 pounds of seed; the seed is shaken in the Spergon for a coating of dust (see also page 30). This

treatment is especially effective for protecting small and expensive seed, such as that of the bentgrasses. Spergon may be mixed with Celite 505 for treating large quantities of seed.

Planting the Seedbed

When the lawn area is properly prepared and leveled, roll the surface lightly while the soil is wet. The roller should not weigh more than 150 pounds. Rolling is needed only to break up small clods that may be just under the surface. Light raking should follow.

If footprints are likely to leave a depression on the surface soil, lay flat boards to walk on while raking and planting. Move the boards backward as the lawn area is sown.

There is considerable variation in the rate of seeding. The rates listed in Chart 1 are based on experiments showing that moderate seeding will often produce a better lawn than heavy seeding, and will lessen the danger of damping-off. Where the seedbed is not of the best quality, and where, for some reason, poor germination is expected, a heavier rate of seeding may be justified.

Gauging the amount of seed. The amount of seed recommended and the thickness of seeding may be illustrated by 1 pound of Astoria bent for 500 square feet of surface. One pound of this seed contains approximately 6 million seeds, practically 98 per cent of which is good. This means that 12,000 seeds per square foot would be sown, a tremendous quantity for so small a space. With germination-tested seed, the soil properly prepared, the seed uniformly sown, and very lightly covered, at least 10,000 seedlings could be started within 1 square foot.

To sow a greater quantity of seed than is recommended in Chart 1 is, therefore, not practical. The thick sowings frequently recommended on packaged seed cannot be justified by any reason.

Sowing the seedbed. Divide the amount of seed into two lots and sow each part in a different direction to insure even distribution. Do not sow on a windy day. Mix very fine seed, such as Velvet bent, with sand for proper distribution. White clover used in the mixture should be planted separately.

Raking in the grass seed. When the seed is planted, lightly rake the surface of the bed to keep the seed from blowing away. It is important to rake lightly. Too heavy raking followed by too heavy mulching keeps much of the seed from germinating—at a great waste of seed.

Mulching the bed surface. After the grass seed is planted on the smooth soil surface, scatter over it screened coarse sand or pulverized peat moss to a depth of about $\frac{1}{8}$ inch, or just deep enough to protect the bed from drying out after watering. A sand mulch is especially good in hot weather. It insures both adequate drainage and aeration, important for good germination.

Since the presence of light seems to aid the germination of grass seed, mulch the seed very lightly. **Seed too deeply buried will not germinate.** The seed of Alta fescue can be mulched a little deeper than most other seeds.

Rolling the mulched bed. Before the seedbed is watered, roll the area with a light-weight roller. Grass seed weighs so little that it becomes fixed when only lightly compressed. Rolling compacts the seedbed by pressing all seeds close to the moist soil, a process that hastens germination.

Watering the new planting. If the bed is watered immediately after rolling, use a very fine mist spray that will

not disturb the mulch covering. The cover must not dry out or bake while the seeds are germinating and the young seedlings are breaking through the surface. On the other hand, excessive surface moisture favors damping-off and rotting of the seedlings, especially in cool weather, so water only often enough to keep the seed moist. Watering once or twice a day in good growing weather is suggested, although one thorough sprinkling a day should serve.

Predicting time of germination.

Beginners often want to know how long a particular kind of grass seed takes to germinate. The time varies with the grass, the temperature, and the season. Ryegrass usually begins to germinate in 7 or 8 days. Kentucky bluegrass takes about 14 days at moderate temperature, longer in cool

weather, and slightly less in warm, growing weather. Bermudagrass planted in warm spring weather should germinate in about 14 days. The fescues take about the same length of time as bluegrass. Most bentgrasses germinate in a period of 10 to 14 days.

Protecting the young lawn. Fence the new lawn until it is well established. Use galvanized wire netting, wooden crate tops, or any other material that will form an adequate barrier. Children and pets especially can be hard on a new lawn. Construct the fence by driving stakes at the edge of the lawn at suitable distances and nailing a thin wooden rail at a height of 2 to 3 feet. Fasten wire netting or some kind of slats to this railing. Keep the fence in place during the period when the grass is young.

Planting Lawns by Sodding or Sprigging

Sodding means starting a lawn with pieces of sod rather than seed; sprigging, starting it with stolons. A few kinds of grass—U-3 Bermuda, Kikuyu, St. Augustine, centipede, and zoysia—set very little seed, or the seed may be scarce. Sodding or sprigging therefore may be required.

California nurserymen occasionally sell sod of various grasses. However, sod-

ding is not a popular way to start grasses that furnish seed at a reasonable cost, such as most bents, fescues, ryes, bluegrass, and ordinary Bermudagrass. Some specialists have suggested covering bentgrass stolons with about 1 cubic yard of top dressing per 1,000 square feet of lawn to help the stolons become well established.

Maintaining the Lawn

Among the more commonly found causes of lawn decline are either insufficient or overabundant irrigation; poor drainage or surface compaction; too close or too frequent cutting; lack of soil fertility; and diseases, pests, and weeds. Each of these factors deserves careful attention. The control of diseases, pests, and weeds is discussed in a separate section.

Important, too, in the subject of lawn maintenance is the kind of tools and equipment used and their care.

Irrigating. It is important to maintain favorable soil moisture at all times.

The rate of moisture penetration, especially in soils of fine texture, is often so slow that ordinary irrigation does not supply enough water. Attempts to remedy this condition with a spiking tool (fig. 12) are relatively ineffective. Even though the tines form small basins in which to hold the water, the sides are too compacted to permit water penetration. The cutting out of small cores with a hollow-tined fork (fig. 13) is more successful. The most satisfactory procedure is to prepare the soil properly in advance of planting and, when irrigating, apply water more slowly.

One inch of rain in 24 hours is considered a heavy rain. Most lawn sprinklers apply water at the rate of at least 1 inch an hour; very few soils can absorb water this quickly. Penetration can be satisfactory without mechanical means by repeated light sprinkling. Let the sprinklers operate until water begins to run off, then turn them off for a while, and repeat the process several times. Another good method is to use a porous hose or soil soaker, which keeps the surface of the soil continuously wet without sufficient volume of water to produce runoff.

If a lawn is suffering from drought, careful watering will usually improve growth more effectively than mechanical

treatment. Semipermanent improvement will result from letting the grass grow tall once or twice a year before a mowing. It must be emphasized that possibly the most effective method of soil improvement is to grow a fibrous-rooted crop, such as an ordinary lawn grass. If a good vigorous top growth is allowed to develop, the roots will also extend and open up the soil.

Eliminating surface compaction.

In spite of good soil preparation, some hard spots may form on the lawn, and these can interfere with the penetration of water and soluble fertilizers. When members of a family walk in a single path across the lawn, or when children play on grass that is wet, the surface soil will be compacted.

The best methods for overcoming surface compaction are a slow soaking of the soil to insure adequate penetration of water, stimulating the growth of the grass with fertilizers, mulching with surface soil or suitable compost, and mowing the lawn less regularly.

Very hard compaction may require soil treatment with some sort of tool. The spiking should be done when the soil is dry.

Mechanically driven machines are available for opening up compaction in large areas of lawn. These machines are called aerators, although their purpose is not primarily to promote aeration but to improve the rate of water infiltration. No doubt the treatment does increase the oxygen supply in addition to increasing water intake. If it is possible to wet the soil even through some method of slow soaking, spiking or other mechanical treatments for opening the soil will be unnecessary.



Fig. 12. The spiking tool in fine-textured soil compacts the sides of the basins it forms so that water will not penetrate easily. Fig. 13. The hollow-tined fork, on the other hand, cuts out small cores but leaves the sides of the soil open to easy water penetration.

Mowing (clipping) and raking.

Several types of lawn mowers can be bought. The most widely used mower has 5 cutting blades (fig. 14); other mowers have only 4 blades. Bentgrass lawn mowers may have 7 or more blades. There is also considerable difference in the weight of these mowers. The handles of some of the new ones are made of bent metal pipe, while those of the older types are of wood. Most mowers now have rubber tires. Whatever the model, the blades should be adjustable so that a keen cutting edge can be maintained at all times (see fig. 14). The height of the roller attached to the mower may be adjusted by set screws to regulate the closeness of cutting. On most lawns the young grass should not be cut closer than $1\frac{1}{2}$ inches.

The first cutting can be given when the young grass is about 2 to 3 inches tall, by which time the grass should be well rooted. A few days before cutting, roll the lawn with a light-weight roller to compact the surface. This helps to protect the young grass during the first clipping. For cutting an established lawn, set the mower blades for 1 to $1\frac{1}{2}$ inches. Golf turf is cut closer, but close cutting is not recommended for the ordinary home lawn.

Several tools are available for edging the lawn. Many people still use hand clippers of some kind (fig. 14) to clip the lawn edge after each mowing. The cutter type of edger (fig. 14) saves hand labor and quickly finishes the job. Dealers can also furnish a combination edger and clipper (fig. 14) for cutting close to curved walks and plants in narrow spaces where a standard lawn mower cannot be used. Special equipment for edging will not be necessary if a layer of brick or flagstone is set at the lawn border. A trim, neat edge can thus be maintained with

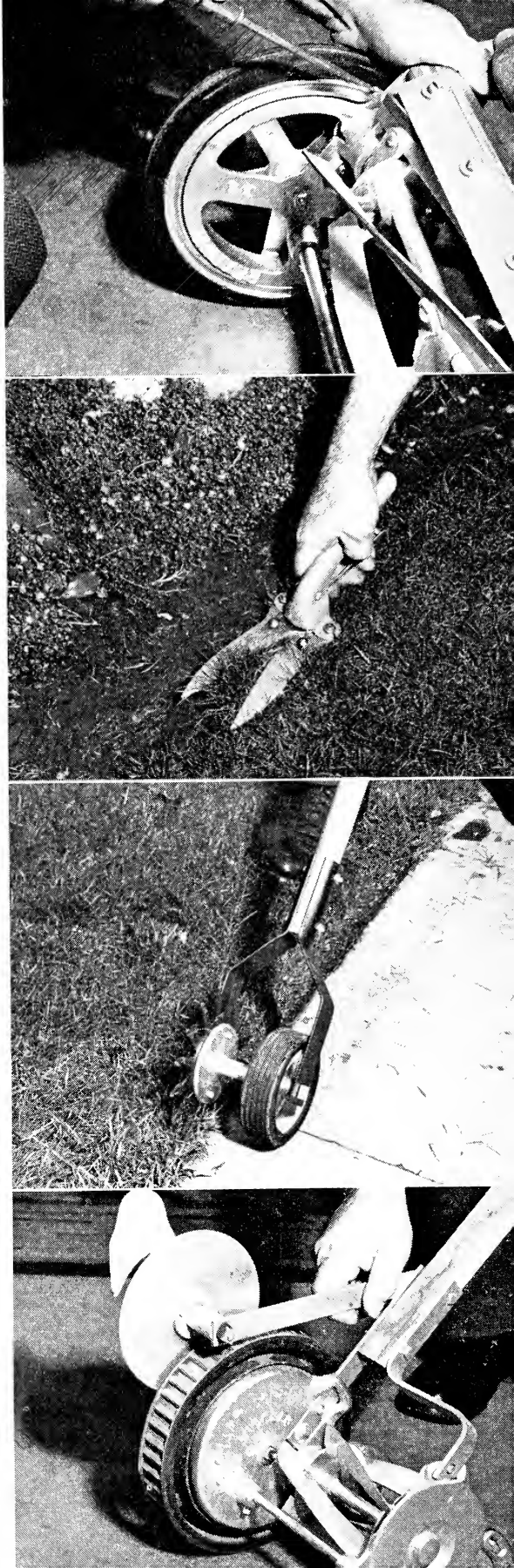


Fig. 14. In lawn maintenance such tools as those shown from top to bottom in this panel are used: the 5-bladed lawn mower; hand clippers; the cutter type of edger; or the combination edger and clipper.

little labor. The border need not be wider than 5 inches.

During winter months, lawns make so little growth that regular cutting is unnecessary, but most lawn grasses should be clipped at least once a week during the season of rapid growth. Some bentgrass lawns are mowed three times a week, but fescues and bluegrass, as well as ryegrass mixtures, can usually get along with one mowing a week. The new Merion variety of bluegrass grows slowly and will not require mowing as often as the common Kentucky bluegrass.

Lawn clippings are usually left on the lawn at the first cutting. After the lawn is well established, the clippings either may be removed or left on. If they lie in a very thick layer remove them with a rake (fig. 15). Clippings left on during the dry months will dehydrate quickly and should add to the organic matter in the soil, but remove them in wet weather. Cross-raking at regular intervals will disclose creeping weeds; raking may not be required, however, in weed-free lawns unless the grass forms a thick mat or nap on the surface.

Fertilizing. Grasses do well in a wide range of soil reaction if they are given plenty of nitrogenous fertilizer and, in

some locations, a phosphate. There are only a few sites in California where local experience has indicated a need of potash. Clover cannot be planted in too acid a soil. It usually requires a higher level of available phosphorus than grasses.

The home gardener should learn how to use the commonly available chemical materials without burning grass or plants. The necessary precautions are: 1) do not apply too much fertilizer at a time; 2) distribute it uniformly; and 3) apply it when the turf is dry, then water immediately.

Fertilizers applied in solid form should be broadcast over the lawn when it is dry. They can be more evenly distributed if mixed with sand or soil and broadcast, half in one direction and half in the other. If there is any dew or other moisture on the grass, it will partially dissolve the dry fertilizers and make a strong solution that will burn the grass. Therefore, immediately after applying fertilizer to a dry lawn, sprinkle the lawn with a sufficient amount of water to wash the materials off the grass and down into the soil.

Any of the fertilizers mentioned here may also be applied in liquid form. This is done by dissolving in 10 gallons of water the amount required for 100 square feet and sprinkling this liquid over the area with a sprinkling can. Mechanical devices for feeding the dissolved materials into the irrigation stream or hose can also be purchased.

The most commonly used nitrogenous fertilizer is sulfate of ammonia, which can be applied at the rate of $\frac{1}{5}$ to 1 pound to 100 square feet of lawn per application. Ammonium nitrate is another satisfactory nitrogenous fertilizer, used at rates up to but not more than 10 ounces per 100 square feet per application. If phosphorus is needed in addition to nitrogen, a material such as ammonium phosphate-sulfate (16 per cent nitrogen, 20 per cent phosphoric acid) can be applied up to 1 pound per 100 square feet for each application. Some gardeners pre-

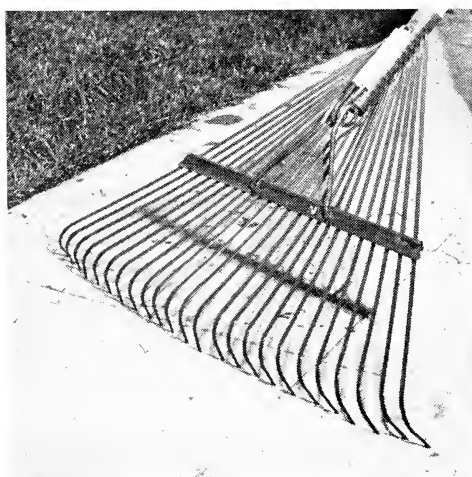


Fig. 15. The light-weight, wire- or bamboo-pronged rake easily removes grass clippings.

fer to use as many as five light applications at intervals of 4 weeks during the growing season, with as little as 2 pounds per 1,000 square feet.

Some people like to use a mixed fertilizer. One commonly sold is a so-called 6-9-6 fertilizer (6 per cent nitrogen, 9 per cent phosphoric acid, and 6 per cent potash). A fertilizer of this kind must be applied dry. One to 3 pounds per 100 square feet per application are reasonable rates. Similar fertilizers are sold in liquid form. The concentrated liquids are very corrosive and must be diluted as directed on the container to avoid burning.

Organic fertilizers, such as sewage sludge, dried blood, cottonseed meal, and alfalfa meal, are excellent lawn fertilizers, but are usually more expensive than the chemical materials. Too, they are disappearing from the fertilizer market in favor of their value as animal feed. There is no danger from burning by organic fertilizers. They take effect more slowly than chemical fertilizers, with longer-lasting benefit to the soil. Rates for using organic materials are suggested.

Organic material	Lbs. per 100 sq. ft. of lawn
High-grade sewage sludge	5
Alfalfa meal	10
High-grade manure	10
Cottonseed meal	5
Dried blood	2

Chemical materials used at the larger of the suggested rates ordinarily are ap-

plied three or four times a year; organic materials applied in larger amounts, once or twice a year. Chemical fertilizers may be used in the summer months and supplemented with organic fertilizers in the wet months of the year. It is unnecessary to work any of the chemical fertilizers into the soil. The nutrients are carried in gradually by irrigation or rain.

Caring for lawn tools and equipment. Keep all clippers, edgers, and mowers properly cleaned and oiled to hold a sharp cutting edge. Before oiling, remove rust with fine sandpaper or steel wool. Thoroughly clean and oil all tools before winter storage in a dry tool house or in a waterproof location.

Oiling, adjusting, and sharpening the lawn mower are often neglected. Oiling makes operation of the mower much easier. Adjustment controls the specific cutting height and smoothness. If the cutting blades are not close enough to the cutting bar, a jagged edge instead of a clean-cut edge will result at mowing. If the cutting blades are too close to the cutting bar, the lawn mower will be hard to push. The blades of most makes of lawn mowers are not sharpened by filing. They are sharpened by rotation against an even sharpener, a process calling for a specialist with the right kind of sharpener. Mower blades can be protected by raking all twigs, pebbles, and rocks from the lawn before mowing; and by lowering the sprinkler heads if they are set too high to clear the cutting blades.

Controlling Lawn Diseases, Pests, and Weeds

Diseases. The lawn diseases more commonly found in California include damping-off, brown patch, dollar spot, copper spot, *Helminthosporium* leaf spot, and fairy rings. These diseases are discussed in this section and appear in Chart 3 under the headings of fungus, symptoms, season, and control.

There has been some confusion in the proper diagnosis of turf diseases, and

more work is needed to determine fully the cause of various other lawn diseases in the state. Snowmold, for example, caused by the fungus *Fusarium nivale*, occasionally has been found in central California, but is not believed to be of general concern. A disease known as false brown patch has appeared in eastern states and may occur in California at some time in the future.

Chart 3. Important fungus diseases of lawn grasses, and their control

Disease	Fungus	Symptoms	Season	Control
Damping-off	<i>Rhizoctonia</i> species	young plants rot off, or some seedlings may not reach surface	cold, wet weather	treat seed with Tersan, Cadminate or Spergon; avoid overwatering
Brown patch	<i>Pellicularia filamentosa</i>	dead patches, 5" to 20" in diameter; dark smoky ring at edge; develops rapidly	only during warm weather	Caloclor for diseased spots; avoid overwatering
Dollar spot	<i>Sclerotinia homeocarpa</i>	dead spots, 1/2" to 2" in diameter, yellowish to dirty white in color; spots develop slowly	April to October	treat spots with Cadminate, Crag 531, or Puraturf 177
Copper spot	<i>Gleocercospora sorghi</i>	small dead spots with copper-red color	after or during several days of warm, sultry or humid weather	Puratized 177, Crag 531, or Dupont F531 applied to spots
Helminthosporium leaf spot	<i>Helminthosporium vagans</i>	straw-colored spots with dark borders on leaves, as on bluegrass leaves	cool, moist weather from fall to spring	spray with phenyl mercurials, PMAS, or Puraturf
Fairy rings	mostly <i>Agaricus</i> and <i>Marasmius</i> species of <i>Basidiomycetes</i>	appearance of dark green rings several feet in diameter in lawn, followed later by mushrooms	in spring or cooler months of the year	treat soil with magnesium products, such as magnesium sulfate or magnesium phosphate; an acid soil is unfavorable to the fungus.

Damping-off occurs in California in two forms: preemergence damping-off and postemergence damping-off. Continued spells of cold, wet weather after grass seed is planted favor the growth of the fungi responsible, and the same factors retard germination and growth of the grass seedlings. Poor drainage, too frequent watering, and too thick planting all favor damping-off.

The *Rhizoctonia* fungus is believed to be the fungus most commonly associated with damping-off. If the fungus kills the seedlings before they emerge, the trouble is called preemergence damping-off; if it attacks the young seedlings, it is called postemergence damping-off. Some of the failures to secure a good stand may be caused—at least in part—by this fungus. Occasionally, good germination is fol-

lowed later by a serious loss of the young grass, especially where the grass is too thick and where it remains very damp during cold, wet weather.

Several fungicides can be used to treat grass seed before planting to help reduce danger from damping-off. Among those tested and found to be promising are: Tersan at 5 ounces, Cadminate at 3 ounces, and Spergon W (wetable) at 3 ounces, each per 1,000 square feet of lawn. Thiosan and Caloclor have been used on small patches of damping-off to check its spread.

Sometimes the best control is to provide better drainage. There is no very good substitute for satisfactory soil preparation in fighting some of the turf diseases. In young lawns, proper soil preparation should help to insure good drainage, and seed treatment to aid further in preventing most of the damping-off.

Brown patch (large brown patch) may appear in circular or irregular patches varying in diameter from 5 to 20 inches. There is usually a dark, smoky ring at the edge of the dead turf. Such spots may rapidly develop and as rapidly disappear. Since the disease appears and develops only in warm weather, it may not be found until June or July, whenever the weather is warm. Lower soil and air temperatures may delay its appearance near the coast, whereas higher temperatures in warm inland areas may hasten it.

Brown patch is caused by the fungus *Pellicularia filamentosa* (syn. *Rhizoctonia solani*). National trials in 1949, as reported by the Division of Plant Pathology, University of California at Los Angeles, showed that in all experiments Caloclor gave consistent control of brown patch. Such compounds should be used according to the manufacturer's directions. Poor drainage and excessive watering, combined with hot weather, may increase this disease on some grass varieties, especially on bentgrasses. Gardeners may need to distinguish between brown

patch and sod webworm damage. If no worms are found, then brown patch may be suspected.

Dollar spot kills the grass in small spots $\frac{1}{2}$ inch to 2 inches in diameter; hence, the name of dollar spot. The spots are yellowish to dirty white, and enlarge slowly or may persist at one size for weeks. In California the disease is prevalent from April to October, or during the warmer months of the year. The fungus *Sclerotinia homeocarpa* is the cause. The more promising chemicals used in control include cadmium products, such as Cadminate, Crag 531, and Puraturf 177. Caloclor has given satisfactory control in some plots at the University of California at Los Angeles.

Helminthosporium leaf spot (bluegrass leaf spot) may attack Kentucky bluegrass, annual bluegrass, and some other grasses during cool, moist weather from fall to spring and thin out the stand of grass. Straw-colored spots with dark borders appear on the leaves. The fungus *Helminthosporium vagans* is responsible. Tests on grass plots at the Rhode Island Agricultural Experiment Station indicate that the phenyl mercurials, such as PMAS and Puraturf, give very effective control.

Copper spot is caused by the fungus *Gleocercospora sorghi*. Small copper-red spots, similar in size to dollar spot, appear in the lawn. In California this trouble may come only after several days of warm, sultry weather or during spells of such weather. It develops in turf temperatures ranging from 65° to 85° F, as observed by C. C. Wenham in Pennsylvania. Various materials appear to be effective in control, including Puratized 177, Crag 531, and Dupont F531.

Fairy rings are certain mushrooms or toadstools in the *Basidiomycetes* group, which form rings in a lawn. Some eastern studies place most of the responsibility on species in the *Agaricus* and *Marasmius* genera.

Where fairy rings are serious enough to justify control measures, the gardener

may apply magnesium products, such as dolomitic limestone and Epsom salts (magnesium sulfate or magnesium phosphate). Commercial mushrooms will not fruit where the soil has a reaction much lower than pH 6.0. By keeping the soil fairly acid for bentgrasses, which tolerate acid soils, fairy rings may not appear. Gardeners with other lawn grasses may wish to try one of the magnesium products until further experiments have been made in California.

Preventing lawn diseases. There are certain general precautions in lawn planting and care that will go a long way toward preventing the occurrence of diseases. Better soil preparation, adequate drainage, more careful watering and fertilizing, and higher clipping are all important factors.

Use resistant grasses where they are known to be satisfactory, and avoid using grasses known to be susceptible to certain diseases under unsatisfactory conditions of soil and exposure. For example, the bentgrasses seem to be more susceptible to brown patch than are most other lawn grasses. Velvet bent is reported to be more subject to copper spot and less to dollar spot than some other bents.

Good drainage is important. Better aeration may be needed to improve water percolation. The tools now available for eliminating soil compaction in lawns are described on page 26. Overwatering a lawn favors some grass diseases. Water should be applied in the early part of the day so that the leaves will dry off quickly before evening.

Various sprays and dusts are being used effectively in the control of grass diseases, but it is too much to expect that fungicides will completely solve the problem where unfavorable soil conditions are largely responsible for the fungus troubles developing.

It is not possible to change the general environment greatly; therefore, diseases may appear in spite of all the precautions taken, yet they can be held at a minimum

through good lawn management and the use of control measures.

Pests. These include sod webworms, grubs, and other insect pests, such as the skipper butterfly larva, ants, and earthworms. Included in this section, also, are moles, pocket gophers, and birds.

Sod webworms cause great damage to lawns in California during the warmer months, especially July, August, and September. The moths begin to fly as early as May. The worms prefer young lawns of bentgrass and even attack bluegrass. Their presence in the lawn is indicated by repeated dying-back of the new grass shoots, until, finally, irregular dark-brown spots appear. These rapidly growing spots seem to come overnight. A close examination will show that the leaf blades are eaten.

Adult sod webworms are small, whitish or gray moths, which hide in the shrubbery all day and fly over the lawn at dusk. They fold their wings close to the body when at rest, which makes them look slender. The eggs scattered over the lawn hatch within a week. In warm weather the worm stage lasts 3 or 4 weeks. During this time the age of the worms is shown roughly by their length: about $\frac{1}{8}$ inch when a week old; $\frac{3}{8}$ inch when 2 weeks old; $\frac{5}{8}$ to $\frac{3}{4}$ inch when 3 weeks or older.

The very young worms make skeletons of the grass blades. The older worms eat the greener parts of the grass crown, the tender growing tips, and even the grass blades themselves. As the worms grow older, they eat more heavily. Before emerging as moths, the mature worms go through a pupal or resting stage, which lasts about a week.

The presence of worms in a lawn may be detected by breaking apart some of the dying sod. Three or 4 lawn-moth caterpillars in a 6-inch-square section will indicate webworms. A more reliable test is to sprinkle a square yard of lawn with water-miscible pyrethrum extract at the rate of 1 tablespoon to a gallon of water. This treatment brings the older worms

to the surface. If no worms appear, the trouble may be caused by a fungus, lack of water, poor soil, improper fertilization, or such lawn insects as grubs or skipper butterfly larva. Several materials have been used to control sod webworms.

DDT in a 50 per cent wettable form, 1 pound to 100 gallons of water, may be applied by sprinkling can or by compressed-air hand spray at the rate of $\frac{1}{2}$ gallon to the square yard (1 pound is enough to treat 200 square yards or 1,800 square feet); or 1 level tablespoon of 50 per cent DDT to 1 gallon of water may be applied by sprinkling can at the rate of 3 gallons to 150 square feet. A 5 per cent wettable DDT dust may be sprinkled over the surface and watered in, allowing about 1 pound of the 5 per cent dust to about 45 square feet of lawn. All wettable dusts should be stirred in just enough water to remove the lumps before the full amount of water is added. At the present time the DDT treatment is one of the least expensive.

Lead arsenate, 5 pounds to 50 gallons of water, may be applied by sprinkling can at the rate of $\frac{1}{2}$ gallon to the square yard (5 pounds are enough to treat 900 square feet). This half-gallon quantity will contain approximately 5 level tablespoons of lead arsenate. Do not let the lead arsenate settle at the bottom of the container. Get a thorough mixture by putting the lead arsenate in the bottom of the sprinkling can and filling the can with a strong stream of water.

Lead arsenate is poisonous to both humans and animals and should be handled cautiously. If animals eat grass coated with lead arsenate, they may die.

Chlordane in wettable powder form has been used recently with success in controlling sod webworms. Allow about 5 pounds of the 40 per cent wettable powder

or 4 pounds of the 50 per cent wettable powder to 100 gallons of water, and apply at the rate of 7 to 10 gallons to 1,000 square feet of lawn. On a small scale, allow 3 or 4 level tablespoons of the 40 per cent wettable chlordane or 3 tablespoons of the 50 per cent wettable powder per gallon of water and apply 3 gallons to 150 square feet. To control sod webworm on a large scale, allow from 5 to 6 pounds of actual chlordane to the acre of lawn. The material also is successful in the control of earthworms and is one of the best materials in the control of ants. If the manufacturer gives specific directions for the use of chlordane in the control of a lawn pest, follow these directions. To avoid possible burning of tender grass with this material, use it in not less than 10 gallons of water to 1,000 square feet of lawn.

Chlordane is poisonous. Do not inhale either dust or spray.

Dichloroethyl ether, diluted 1 part to 400 parts of water ($\frac{1}{3}$ ounce to the gallon), is applied by sprinkling can at the rate of 1 gallon to the square yard (allow about 300 ounces or $9\frac{1}{2}$ quarts to 900 square feet). If pure dichloroethyl ether is used, place the proper quantity in the bottom of a sprinkling can and direct a strong jet of water into the can, preferably from a hose nozzle. When the container is about two-thirds full, a white foam should appear. This indicates that the material has gone into solution. If foam does not show, the spray will not be effective; in fact, it may injure the lawn. Commercial products containing dichloroethyl ether are treated to go into solution readily. These products call for $\frac{1}{3}$ ounce of dichloroethyl ether to a gallon of water per square yard of lawn.

Gardeners are warned that where dichloroethyl ether is not in proper solution, parts of the spray material may be

strong enough to injure the lawn. Benzene hexachloride (in the form of lindane) is another insecticide that is being tested and may offer some promise of control.

Several hours before applying these liquid insecticides, water the lawn. It is not necessary to soak the insecticide into the soil to control sod webworms, but the spray should wet the grass down to its base. After applying the spray for sod webworm control, do not water the lawn again for several days or until necessary.

Wettable DDT, lead arsenate, chlordane, and products containing dichloroethyl ether can be bought at seed and fertilizer stores or in larger quantities from insecticide manufacturers. Pure dichloroethyl ether is available at chemical companies and wholesale drug supply houses.

The methods described will control sod webworms in the lawn at the time of application. However, each method has its good and bad points, and each must be judged by the fact that during warm weather an infestation of sod webworms can build up in as short a time as 3 weeks. That is why it is necessary to use an insecticide with a prolonged killing effect. Although dichloroethyl ether treatment has a rapid killing action, it has little residual value. On the other hand, experiments indicate that DDT, lead arsenate, and chlordane sprays are effective for a month or longer.

White grubs are of the usual crescent shape and feed mostly on the roots of the host plant. Some eastern reports indicate that white grubs are not controlled by DDT or chlordane, at least not at the usual concentration. The lead arsenate treatment has been standard in the past and should be used in preference to others. Water the lawn thoroughly after application to wash the lead arsenate into the soil. Allow 10 pounds of lead arsenate to 1,000 square feet for the control of white grubs.

Skipper butterfly larvae can very likely be controlled by the same measures that control sod webworms, although

there is little experimental evidence available. Chlordane also seems to give excellent control of the fiery lawn skipper.

Ants do not usually attack the grass directly, but their nests at the edges of the lawn may cause some destruction. Frequent watering usually discourages the building of nests. Applications of wettable chlordane at the same strength as that suggested for sod webworms will aid in control.

Earthworms (night crawlers) become a nuisance in lawns by piling up mounds of earth. They can be controlled by corrosive sublimate diluted at the rate of 2 or 3 ounces in 50 gallons of water. This amount is enough to treat 1,000 square feet of lawn. The lawn should be watered after this treatment. Lead arsenate has also been used at the rate of 5 pounds per 1,000 square feet of lawn and spread evenly over the surface of the grass before watering. Wettable chlordane, discussed under sod webworms (page 32), also gives some control.

These chemicals are highly poisonous. See that children and pets do not come in contact with them.

Moles in search of worms and insects frequently make runways or tunnels through a young lawn, loosening the grass, which becomes badly dried out. They sometimes work in older lawns if the soil is loose.

Moles do not leave open runways as gophers do, although they sometimes push up a small mound of earth. Shallow runways or tunnels just under the surface of the soil usually indicate their work. Trapping with a standard mole trap is considered the best method of control. Set traps in repeatedly used tunnels. Step on the tunnels to find which ones are in use. Frequently used tunnels will give under pressure. Moles will not readily accept poison baits, although earthworms have been poisoned in various ways and

placed in the runways. (For further information, see "Control of Field Rodents," California Agr. Ext. Cir. 138.) Repellents, such as naphthalene flakes, lye, and paradichlorobenzene are not always effective with moles.

Pocket gophers push up mounds of earth and leave the entrance to the runway open for a short time. Usually the runway branches down a short distance from the mound, and the nest is located in the direction of the oldest mounds. Either poison with strychnine or trap by gopher trap. The Macabee wire trap is popular. Set the trap lightly and place it in the runway, where its jaw will close quickly after the trap is sprung. Use strychnine sulfate or alkaloid on pieces of carrots, prunes, or on the thick midrib of cabbage and cauliflower. If the bait is placed in an open runway, cover the entrance to the runway. Locate the runway near the mounds with an iron prod, and drop some of the poison bait into the opening.

Protect children and pets against any possible contact with strychnine.

Catching or killing the gophers early in the year before the breeding season starts will often wipe out entire colonies. Fumigating with methyl bromide in a special applicator has been done successfully by trained operators, but the gas is dangerous and may cause serious damage to the roots of nearby plants.

Birds often scratch newly planted lawns, although they are rarely troublesome where the lawn is close to the dwelling. Cover young grass very lightly with brush and leave this on until the birds no longer bother.

Weeds. Most young lawns need an early weeding, perhaps just before the first clipping. Such weedy grasses as farmers' foxtail stool out quickly; all weeds of this kind should be removed with a knife before they have had time to

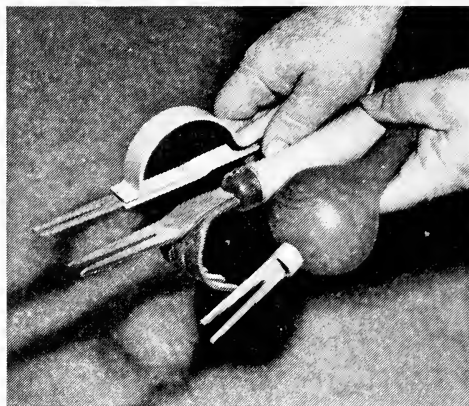


Fig. 16. A hand weeder is satisfactory in removing such weeds as dandelion.

injure the young grass plants. Small annual weeds can be pulled up gently or cut off below the crown. Some broad-leaved weeds that appear in a newly planted lawn never become a problem because they are unable to compete with the grass and with repeated mowing. This is not true of field weeds, however.

Systematic weeding once every 2 weeks may be often enough to control almost any kind of weed. If there are only a few weeds in the lawn, hand-weeding is often the simplest method of elimination. Frequent mowing helps to keep most weeds from maturing seed, and this treatment is one of the most important in preventing the spread of weeds in the lawn.

Among the lawn tools needed in the home garden are a knife for cutting off weedy annual grasses without seriously disturbing the lawn, a hand weeder for lifting out such weeds as dandelions (fig. 16), and a small hand sprayer for applying only weed sprays. If the sprayer is used for any other kind of spray it will need to be thoroughly cleaned between operations.

Most broad-leaved weeds are controlled with 2,4-D, but the 2,4-D sprays are not safe to apply to a very young lawn, especially to young bentgrass and redtop. When applying 2,4-D, be certain to follow the directions given on the package

and see that the spray does not drift to nearby ornamentals. With grasses susceptible to 2,4-D injury, such as bentgrass and redtop, it may be necessary to reduce the strength of the spray solution to about one half that recommended on the label for lawns.

The lawn may be fertilized before applying 2,4-D, so that the grass and weeds will grow vigorously. This will help to stimulate growth and aid in preventing any serious, depressing effect of the weed spray. To avoid damage to susceptible grasses, see that the grass is healthy and is slightly dry before using the spray. Remember, too, that the lawn should not be clipped for several days or a week before spraying and not clipped again until several days after spraying. Do not irrigate immediately after spraying with 2,4-D; wait several hours. In rainy weather, delay spraying until there is a promise of several hours of dry weather. Repeat the

spray as needed to control broad-leaved weeds. If only an occasional weed, such as a dandelion, appears, it may be spot-treated without trying to cover the entire lawn.

Some gardeners fear a depressing effect from the continued use of 2,4-D on a lawn. In general, on a lawn well fertilized and properly watered, 2,4-D will leave no serious effects. Even repeated applications to a healthy lawn will ordinarily not cause trouble. Any possible root damage to a lawn can be largely avoided by taking the precautions suggested.

Weedy grasses are given special attention, with the exception of crabgrass which has been treated with several selective chemicals within recent years. Other weedy grasses, such as Bermuda, Kikuyu, St. Augustine, and Johnson, cannot be killed in a lawn by any kind of selective weed killer. Gardeners who have the prob-

Chart 4. Some common weeds found in California lawns

Annuals	Perennials
Arenaria serpyllifolia (sandwort)	Cerastium arvense (field chickweed)
Capsella bursa-pastoris (shepherd's purse)	Cerastium vulgatum (perennial mouse-ear chickweed)
Cerastium viscosum (annual mouse-ear chickweed)	Cynodon dactylon (Bermudagrass)
Digitaria ischaemum (smooth crabgrass)	Dichondra carolinensis (dichondra)
Digitaria sanguinalis (hairy crabgrass)	Holcus mollis (creeping velvetgrass)
Eleusine indica (goosegrass)	Hydrocotyle sp. (pennywort)
Geranium dissectum (cut-leaved geranium)	Nepeta hederacea (ground ivy)
Malva rotundifolia (dwarf mallow, annual or biennial)	Oxalis corniculata (yellow oxalis)
Medicago hispida (bur clover, annual or biennial)	Plantago sp. (plantain)
Medicago lupulina (black medick, annual or perennial)	Prunella vulgaris (self-heal)
Mollugo verticillata (carpetweed)	Sida hederacea (alkali mallow)
Poa annua (annual bluegrass)	Taraxacum vulgare (common dandelion)
Scleranthus annuus (knavel)	Trifolium repens (white clover)
Sherardia arvensis (field madder)	
Stellaria graminea (grassy starwort)	
Stellaria media (common chickweed)	
Verbena bracteosa (bracted vervain)	

lem of killing such perennial, weedy grasses before planting a lawn may wish to seek the advice of the County Farm Advisor's office.

Crabgrass control is successful if the chemical treatments are started when the first crabgrass seedlings appear, which may be as early as March or April. Two of the several more recent chemicals for selective control are potassium cyanate and phenyl mercuric acetate, the latter sold under such trade names as Scutl and Tat-C-Lect. These chemicals are effective if directions are followed closely. Chemical treatment of old, established crabgrass plants usually is not successful.

More than one treatment will probably be necessary, since seed of crabgrass may continue to germinate throughout the summer. It is best to measure off areas in the lawn and apply chemicals as accurately as possible. Either too much chemical per gallon of solution or too much solution per given area can lead to damage. If too much of the chemical spray is applied, the lawn grass may show some browning, but this usually disappears within a week or two unless extremely heavy dosages are used.

Bermuda, Kikuyu, St. Augustine, and Johnson grasses should be weeded out before the lawn seed is planted and kept out after the lawn is established. Control at present consists of digging out the roots and exposing them to the sun to dry during the warm months. Where the roots cannot be removed completely, if possible fumigate the soil with carbon disulfide.

Repeated applications of special kinds of oil sprays, such as Shell No. 20, Cali-

fornia Spray Chemical Corporation Pentox No. 2, Richfield "A," and Tidewater Associated Annalos No. 11, are also effective in killing small patches of these grasses. Do not let the oil spray touch valuable plants near by.

Oxalis, especially the red creeping form, is one of the weeds that resists selective weed spray. Unless the seedlings of this weed are removed before they start to run, it is impossible to eradicate the plant. Repeated applications of 2,4-D spray at 2-week intervals may help somewhat to control oxalis, but such treatment is considered entirely inadequate. It is, however, the best chemical method available at present. Oxalis and some other weeds may also be discouraged by rather heavy applications of ammonium sulfate, a slightly acid fertilizer.

Annual bluegrass (*Poa annua*) is often found as a weed in lawns, especially in shady places where the lawn grass has died out. This weedy grass is favored by heavy watering. It can be discouraged by avoiding excessive watering, by proper aeration, and by selecting a lawn grass suited to the exposure and climate of the area. As a last resort, certain chemicals, such as isopropyl-N-phenyl carbamate (IPC), may have a place in control. IPC has been used at the rate of 4 to 6 pounds to the acre, or 1 to 2 ounces to 1,000 square feet.

Chickweed is effectively controlled with sodium arsenite, used at the rate of 2 ounces to 1,000 square feet, or doubled in amount if used dry. The dry material can be used with a fertilizer.

Chart 4 lists some of the common weeds found in California lawns.

Renovating a Lawn

Lawn decline may be caused by too-frequent cutting, fungus diseases, pests, rodents, or weeds. It may also be caused by improper watering, loss of soil fertility, soil compaction, too much shade, the wrong kind of seed for local conditions,

or the wrong methods of soil preparation. A declining lawn may be rejuvenated by spiking and reseeding or resodding, by top-dressing lightly, and by replanting to a different and more suitable grass. Fertilizing, watering adequately, and letting

the grass grow until it establishes a good root system before mowing are all very important.

Spiking and reseeding or resodding. Where the soil is badly compacted, especially in spots, irrigate the surface, then spike—preferably with a hollow-tined fork (see fig. 13)—to a depth of 3 or 4 inches. Remove any hard spots in the lawn and replace with new soil of better composition. Then either reseed or, if it can be spared, replant with sod taken from the edge of the lawn. Reseeding or resodding will be necessary where insects or diseases have thinned the stand or have made dead spots.

Top-dressing with soil or compost.

A top dressing once a year in spring will improve most lawns. First mow the grass closely and cross-rake; then spike the turf if necessary and cover the surface with soil or compost. The soil may be ordinary garden soil taken from other parts of the yard. Many gardeners have used a compost consisting of equal portions of loam, peat, screened leaf mold or well-rotted manure, and washed river sand.

There is some danger that a compost of this kind will cause most of the roots to develop in the top dressing. This will produce a shallow-rooted lawn, which is hard to maintain. Any manure in the compost should be free from weed seed and any peat moss free from excessive salt or other harmful material.

Weed a lawn before top-dressing it. Apply the top dressing to a uniform depth of $\frac{1}{4}$ to $\frac{1}{2}$ inch and rake it with the back of a rake so that it comes into close contact with the soil. This kind of top dressing or resurfacing is often used by gardeners in the maintenance of the most beautiful lawns.

Replanting to suitable grass.

Green algae or moss in a lawn almost always indicates that the wrong kind of grass was planted or that at times the grass was kept too wet. Chemical treatment will not protect a lawn against green algae if shade and moisture are wrong. If a shade-tolerant grass is planted, it should not be allowed to thin out and leave spots in which the green algae or moss can grow.

Estimating Certain Costs of Lawn Planting and Care

Contracts have been made for the planting and care of a new lawn until after the second cutting. These average about 10 to 15 cents per square foot, where the lawn is level, and include draining, grading, or hauling in of topsoil. The cost of a sprinkler system is extra, of course. A minimum contract price for establishing 1,000 square feet of lawn at 10 cents per square foot, covering all materials and labor until after the first clipping, amounts to \$100. Any unusual amount of grading or hauling in of topsoil could greatly increase the expense.

Whether the lawn is planted and established by the contractor or by the owner, there is some expense for materials pur-

chased. There is also the expense of a certain amount of necessary labor, for instance, the work of watering daily and of weeding before the first clipping. This expense may be considerable.

An established lawn of 400 square feet may require weekly 2 hours of watering and $\frac{1}{2}$ hour of mowing. A lawn of this size may use weekly, during the warm months, as much as 400 gallons of water and, toward the end of the dry season, when the weather is cooler, about 100 gallons.

These costs are only rough estimates, which may not apply under unusual conditions, but they do give a general idea of what to anticipate.

In order that the information in our publications may be more intelligible it is sometimes necessary to use trade names of products or equipment rather than complicated descriptive or chemical identifications. In so doing it is unavoidable in some cases that similar products which are on the market under other trade names may not be cited. No endorsement of named products is intended nor is criticism implied of similar products which are not mentioned.

Coöperative Extension work in Agriculture and Home Economics, College of Agriculture,
University of California, and United States Department of Agriculture coöperating.

Distributed in furtherance of the Acts of Congress of May 8, and June 30, 1914.

J. Earl Coke, Director, California Agricultural Extension Service.

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